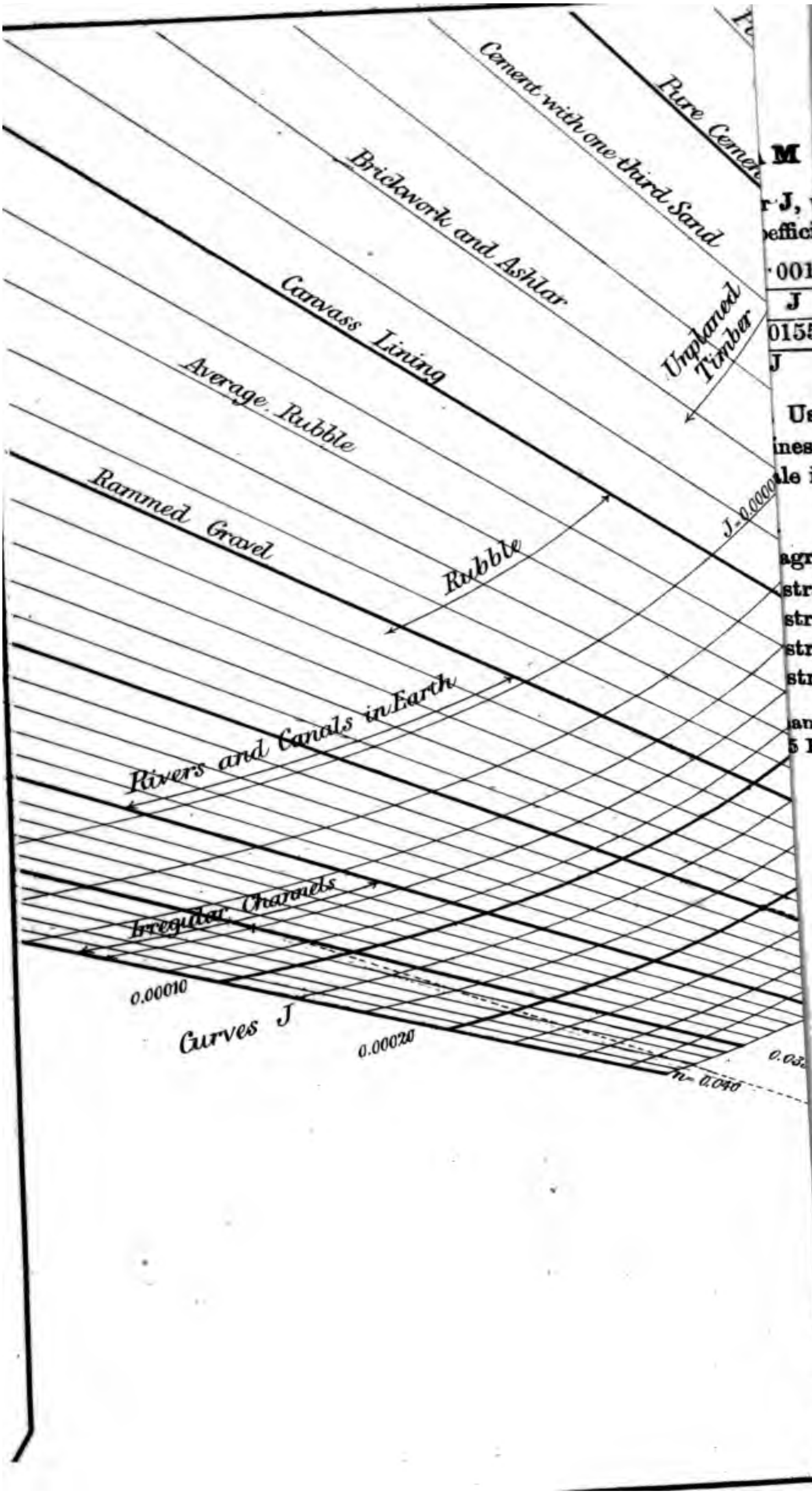
THE NEW FORMULA

FOR

MEAN VELOCITY OF DISCHARGE

OF

RIVERS AND CANALS.



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THE NEW FORMULA

FOR

MEAN VELOCITY OF DISCHARGE

OF

RIVERS AND CANALS.

BY

W. R. KUTTER.

TRANSLATED FROM ARTICLES IN THE 'CULTUR-INGÉNIEUR,'

BY

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AUTHOR OF

HYDRAULIC MANUAL AND STATISTICS; A CURVE BOOK;
SIMPLIFIED WEIGHTS AND MEASURES, ETC.

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PREFACE BY THE TRANSLATOR.

In presenting to the English public in 1876 a translation of a valuable work that appeared in 1870 in Austria, Germany, and Switzerland, and that was immediately translated into French, Dutch, and Italian, it is not so much an acknowledgment of having been tardy in bringing forward results useful to the hydraulician, as it is an indication that the technical English public has been backward in accepting more advanced views on the subject treated.

A strange anomaly has developed itself in the progress of hydraulic science in the British Empire in modern times. While the lead in engineering progress generally, both theoretical and practical, seems to have been almost entirely taken by the English-speaking races, and whilst improved construction, perfected appliances, and higher economy have progressed in the last thirty years at a speed perhaps greater than has ever been previously known, yet in the hydraulic branches of engineering no similar claim can be very satisfactorily made out for our country. This seems at variance with our present requirements. We have in India a vast empire, existing in a state of mutual dependence with England,

whose enormous wealth is dependent on its population, whose population is dependent upon agriculture, and whose agriculture depends chiefly on irrigation; where water is like silver, and the science of its judicious application and control is like gold. We have in semi-tropical regions large colonies, which suffer from devastating floods alternating with drought. At home the catchment areas of our rivers, in fact the country generally, is in a polluted state, the drainage both from farmland and townships being still either badly regulated or under no general control. In spite of the increasing exceptions, the water supply of most of our towns is so contaminated as to conduce amongst other evils to a fearful amount of intemperance; and the sewage, the natural regenerator of soils and crops, is generally allowed to mingle with noxious refuse, or to be so ill-regulated, as regards dilution and application to land, that it not only ceases to be useful, but becomes a source of perpetual pollution.

Yet, in the face of all these circumstances, we find impediments being very frequently raised to the extension of irrigation in India, difficulties magnified, and exceptional failures, due to misapplication and mismanagement, so stated as to appear the rule; we find even in 1871 money refused for purposes of hydraulic experiment, while the adoption of the long-exploded velocity formula of Dubuat was enforced by Government order. In the British colonies, hydraulic improvements are proceeding with a degree of caution and on a scale incompatible with important achievement. At home, vested interests, indecision, parsimony, procrastination, and want of combined action may be said to form the principal obstructions to the development of any extensive

wholesome sanitary regimen. Even when the remodelling of the sewerage of London was being dealt with by the Commissioners of Sewers, the experiments then instituted for determining discharges of pipes of different materials were abruptly stopped before arriving at any useful conclusion.

The result of all this shows itself in the English hydraulic literature of the past, as comprised in the works of Beardmore, Downing, Neville, Box, Latham, &c., where the defective formulæ of Eytelwein, Stevenson, Dubuat, Prony, &c., are used as the bases of calculations of discharge for tables which are still unfortunately believed in by the unreflecting, while any departure from these old principles has been looked upon with suspicion and distrust.

It is, however, highly satisfactory to observe that our most progressive engineering periodical, 'Engineering,' has always been in advance on such subjects. In an article entitled "Hydrodynamic Formulæ," appearing in the year 1873, the results of all the old velocity formulæ, both for open channels and for pipes, are compared; the whole of these formulæ are proved to have no claim to general application; and as a consequence of the dearth of hydraulic observations of modern date, the hydraulician is recommended to use variable coefficients of mean velocity of discharge, to be chosen in accordance with the circumstances of each special case and the nearest similar recorded observation that can be obtained. The article referred to, since embodied in the translator's 'Hydraulic Manual,' shows that, even before the valuable articles of Herr Kutter had attracted notice in England, the erroneous nature of the formulæ we were using was known to some.

At the present day, however, the experiments of D'Arcy and Bazin in France, of Humphreys and Abbot in the United States, and of Ganguillet and Kutter in Switzerland, have become more widely known and studied; and the practical value of the new formula of Herr Kutter, based on the whole of those observations, has become recognized.

The following extracts from another article in 'Engineering,' entitled "Hydraulic Experiments," of the 31st of December, 1875, is also perfectly unsparing in denouncing the old formulæ, and distinct in supporting that of Herr Kutter; while it also calls attention to the need of a translation into English of Herr Kutter's articles in the 'Cultur-Ingénieur.'

"The tabulated velocities (in Neville's work based upon Dubuat) though expressed in hundredths of an inch, are in reality but the wildest guesses at the actual velocities in irrigation canals of ordinary dimensions. Colonel Cautley relied upon Dubuat when he laid out the Ganges Canal, and found him but a rotten reed, for the water in every instance tore along at an unexpected velocity, and erosion of the bed and destruction of the works followed in its wake. Dubuat then must be put upon the top shelf of the bookcase, and it will be just as well, when the steps are there, to carry up every English work in which the names of Brunning, Girard, Bossut, Prony, Eytelwein, or D'Aubuisson are continually recurring as authorities against whom no action can be taken. In this general clearance Beardmore, Downing, Box, and *almost every other hydraulic text-book* compiled by Englishmen will with more or less hesitation have

" been shelved, and the young engineer will then be able "
" to form a fair estimate of the contribution his country- "
" men have made to the common fund of knowledge "
" concerning the laws governing the flow of water. . . . "
" Bazin, Gauckler, and many others have laboured to "
" deduce a comprehensive formula which shall include "
" every case, from a street gutter to a mighty river. The "
" most successful workers in this field are perhaps Gan- "
" guillet and Kutter. Mr. Jackson bases some of his tables "
" upon Kutter, and so far as we know, that is the only "
" instance in which the deductions of the latter have been "
" referred to in an English work. Perhaps it is not too "
" late even now to induce Mr. Forrest to append a full "
" translation of the German original in an ensuing volume "
" of the 'Proceedings.' "

From the above remarks it would appear that our engineering students are still adhering to old habits, although curiously enough the students of the Civil Engineering College at Madras have, at the instance of their principal, Captain Edgecombe, and of the able and enlightened secretary to his Excellency the Governor of Madras, the Hon. Robert Ellis, employed since 1869 an earlier edition of the Manual of the translator referred to, and have therefore gone on more correct principles for some years; while again in December, 1875, the Russian Government had already ordered the translation into Russian of the later edition of the same Manual for use of their engineers generally. Hence it would seem that we are even now rather in arrear in England.

The translation of Herr Kutter's German original, at last evidently wanted, has been rendered less with the intention

of making it scrupulously literal than correct and practically useful; literalism having only been adhered to in certain portions where it appeared requisite: parts of the work have been transposed, and some conversion tables, as well as some tables of equivalents of various foreign measures, which have been revised and corrected in accordance with the standards of 1872, introduced for the convenience of the reader.

L. D'A. J.

ROYAL INSTITUTION, ALBEMARLE STREET,
1st *March*, 1876.

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Figure 1.

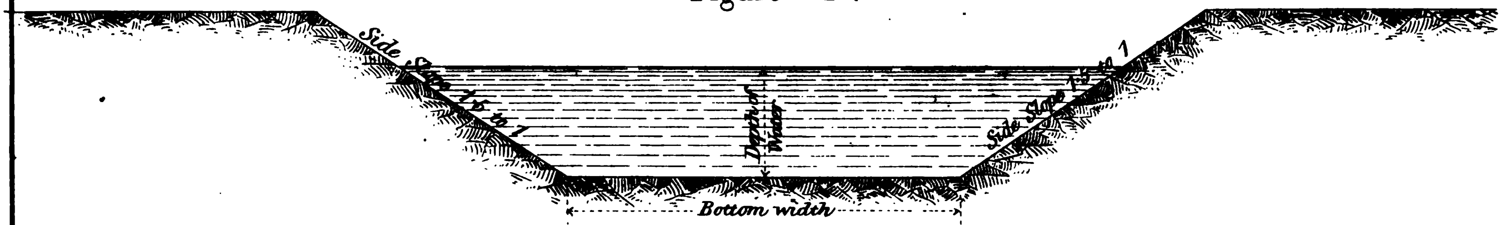
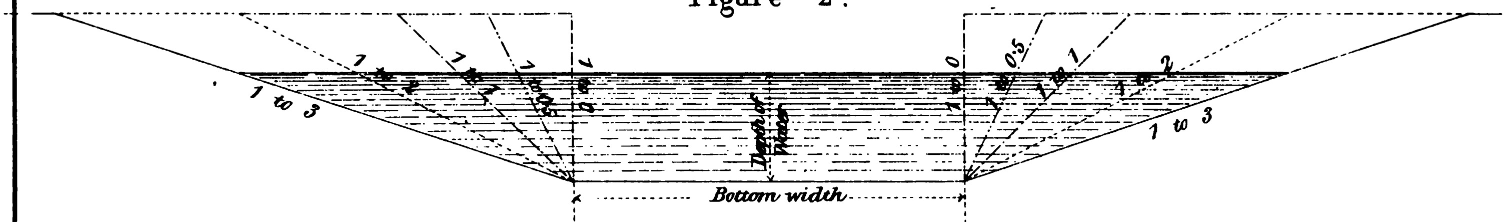


Figure 2.



THE NEW FORMULA FOR MEAN VELOCITY OF DISCHARGE.

CHAPTER I.

1. The New Formulæ of D'Arcy and Bazin and Humphreys and Abbot, for determining Mean Velocities of Discharge of Rivers and Canals.

In recent times two extremely valuable works on hydraulics have been published, which have thrown a new light on one of the most important branches of that science, the laws of motion of water in rivers and canals. They are, the 'Recherches Hydrauliques' of D'Arcy and Bazin, 1835; and the 'Theory of Motion of Water in Rivers and Canals,' by Captain Humphreys and Abbot, 1867, the latter of which was translated into German by Grebenau. These two works far surpass all others yet written that treat on this branch of hydraulics. Both of them bring forward a very large number of results of experiment and observation that have been most carefully obtained and deduced, and are justified by the highest authority; both of them also propose new formulæ, which essentially differ, not only from each other, but also from all previous formulæ of Prony, Chezy, Eytelwein, St. Venant, &c.; this difference is the more striking, as the whole of these formulæ have been based on carefully conducted observation and experiment. In explanation of this, and with reference to the two modern formulæ, we would notice that the two latter are results deduced from observations made under extremely different conditions; those of the French engineers, D'Arcy and Bazin, having been taken on small canals, and those of the American engineers, Humphreys and Abbot, on

very large rivers, like the Mississippi. Both formulæ are correct within certain limits, but neither can have any pretension to general application, as the former of the two is inapplicable to large rivers with low inclinations, and the latter to small discharges with greater fall. To decide which of these two formulæ is preferable and more useful generally, and to enable us to base our decision on practical considerations, we have made a collection of all known observed results that bear on the subject, together with some that are of special interest from having been conducted on streams of extremely high inclination, and have compared these results with those deduced from the measurements by the formulæ.

2. The previously accepted Formulæ.

The well-known formula of ordinary use,

$$v = c\sqrt{rs},$$

in which

- v is the mean velocity of discharge,
- r is the mean hydraulic radius, or the quotient of the water section by the wetted perimeter,
- s is the inclination of the water surface,

and

- c is the experimental coefficient,

is that of Chezy and Eytelwein; it was assumed that it gave correct results under all cases and conditions of inclination and dimension, a fallacy that vanished only after a long time, with the discovery that the coefficient c was not a constant but a variable quantity. In the formulæ of De Prony and Weisbach the coefficients c vary with the velocity of the water, but their results differ but slightly from those afforded by the former formula with the coefficients of Eytelwein. More recent researches have however shown that the variation of the values of c depends on very varied influences, and can be more correctly determined and expressed than by simply treating it as dependent on the variation of the velocity v.

3. The New Formulæ of D'Arcy and Bazin.

In the 'Recherches Hydrauliques' of D'Arcy and Bazin, 1865, the coefficients c are made to vary, not with the velocity, but with the values of r, the hydraulic mean radius, and with the conditions of the section. These conditions are classed in four categories, which, naturally, do not include every degree of roughness of the wetted perimeter, but are merely averages assumed for convenience in determining the coefficients. D'Arcy and Bazin have deduced their formulæ from their own new experimental observations on artificial canals, 2 mètres wide, 1 mètre deep, and about 600 mètres long, whose beds and banks were constructed of various different materials, as well as from other observations on rivers and canals. They gave various forms to the section of their canal, and thence discovered that the semicircular form was that most favourable to a rapid discharge, while they also demonstrated that the form of section was not by any means the most important influence on the velocities and discharges of open channels.

4. The New Formula of Humphreys and Abbot.

The American engineers, Humphreys and Abbot, proposed an entirely new formula, based on a vast number of frequently repeated measurements of discharge on the lower Mississippi and its affluents. At page 138 of Grebenau's translation of their work, we find that the extremely ingenious formula deduced by them for velocity is based on the following law, established by their own experiments: That the velocities at different depths below the surface in a vertical plane vary as the abscissæ of a parabola, whose axis is parallel to the water-surface, and represent the maximum velocity; and thus, the position of this axis once determined, the velocity at any depth in this vertical plane can be obtained

from the parabolic curvature. This law is also confirmed by the experience of D'Arcy and Bazin. Since, therefore, this new formula is deduced from observations on large rivers of low inclination, and has also been proved to hold good for rivers and small streams with small inclinations, it becomes important to discover whether it is also correct for discharges of high inclination. Should that be the case, it will then have a claim to general application.

5. Practical Examination of the New Formulæ.

The collection, given on the following page, of observed measurements of discharge on the Wildbachschalen, near Lake Thun, under conditions of very high inclination of channel, affords a ready answer to this important question, without entering into unnecessary details or lengthy discussion. The data and dimensions there given, the observed velocities of discharge, and the velocities calculated according to the well-known formulæ of Chezy-Eytelwein, of D'Arcy and Bazin, and of Humphreys and Abbot, comprise everything that is required.

Besides those above mentioned, we have collected another series of measurements of discharge in Switzerland, that is also applicable to this question; some of them are from streams on the Jura series by Professor Trechsel, some from well-maintained river channels in Canton Graubündten by Oberst La Ricca, and others from the Linth-and-Escher canals by Engineer Legler. The whole are eighty-five in number. The comparison of the observed with the calculated results shows that for steep inclinations the American formula gives far too small velocities of discharge, and that the formulæ of D'Arcy and Bazin give results which are generally much better, and in some cases very good. We hence infer that the American formula has no claim to

general application, and would be much improved by the introduction of variable coefficients. The conclusion is also forced on us, that any formula that would possess any adequate claim to universal utility must necessarily be very complicated, and hence unsuited to practical requirements, while it appears at the same time that if a good general formula, somewhat resembling that of D'Arcy and Bazin, be adopted as a basis, and a collection of correct coefficients be applied to it, every purpose will be sufficiently served. It must, however, be noticed that any such formula must be applicable to all ordinary hydraulic conditions, and that the choice therefore lies between the old general formula, which admits of adaptation to those of D'Arcy and Bazin, and the new American formula.

TABLE OF OBSERVATIONS ON THE WILDBACHSCHALE.

Dates.	Length.	r	Inclination or Fall per 1000.	Observed Velocity.	Calculated Velocities.		
					Chezy-Eytelwein.	D'Arcy and Bazin.	Humphreys and Abbot.
G'rünnbachschale.							
3rd June, 1867	800	0·394	106·775	13·97	19·07	13·68	3·50
" "	1200	0·385	99·270	13·54	18·18	12·93	3·37
" "	200	0·361	82·85	12·00	16·08	11·17	3·11
27th June, 1867	800	0·657	106·775	19·48	24·63	20·69	4·56
" "	1200	6·644	99·27	18·58	23·51	19·65	4·42
" "	200	0·591	82·85	15·79	20·57	16·77	4·04
Gerbebachschale.							
27th June, 1867	100	0·197	237·3	10·31	20·10	11·20	2·97
" "	100	"	185·2	9·58	17·76	9·90	2·78
" "	400	"	167·9	9·33	16·91	9·42	2·71
" "	100	"	137·5	9·05	15·30	8·53	2·57
" "	100	"	111·7	8·61	13·79	7·69	2·43
Gontenbachschale.							
26th June, 1867	400	0·375	46·425	11·15	12·26	8·64	2·72
" "	600	"	42·350	10·05	11·71	8·25	2·65
" "	400	0·328	46·425	10·66	11·48	7·70	2·53
" "	600	"	42·350	9·60	10·96	7·36	2·47
Summation of results ..	..	..	..	181·70	252·31	173·58	46·83
Ratios	..	..	..	1·00	1·39	0·96	0·26

6. Examination of the Old-established Formula and the New American one, with the View of applying Series of Coefficients to either of them as a Basis.

The old formula, $r = c\sqrt{r\,s}$, whose terms have already been explained, may be said to assert the general law that the mean velocity of discharge at any section varies with the square root of the product of the sine of the inclination and the mean hydraulic radius. The value of the experimental coefficient c may be shown to vary greatly; although fixed as a constant quantity 92·975 by Eytelwein, it has yet been proved by the experiments of D'Arcy and Bazin to vary between 5 and 100, while the results on the Mississippi give it not less than 256 as the highest limiting value.

The new American formula, expressed in Swiss feet, is

$$v = \sqrt{0 \cdot 008\ 299\, b + [229 \cdot 06\, r_1 \sqrt{s} - 0 \cdot 090\ 716 \sqrt{b}]^2},$$

where

$$b = \frac{1 \cdot 7034}{\sqrt{r} + 1 \cdot 524} \quad \text{and} \quad r_1 = \frac{a}{p + \mathrm{W}}.$$

To simplify this rather complicated expression, Grebenau neglects the two smaller quantities represented by the first and third terms of the equation, and reduces it to the form

$$v = c\sqrt{r_1}\sqrt[4]{s},$$

which may be thus verbally expressed: The mean velocity of discharge at any section is the product of the square root of the prime radius or quotient of the sectional area by the whole wetted perimeter and breadth of surface, and the fourth root of the inclination, multiplied by an experimental coefficient. The introduction of the breadth of surface of the water section into the quantities composing this equation, and the resulting substitution for r, the mean radius, of

a new term r, or prime radius, which is about a half of the former, causes a great alteration in the corresponding values of the coefficient. A still more important difference between the American and the old formula is the introduction of the fourth root of the sine of the inclination into the basis of the formula, instead of the square root; the law of increment of a series of fourth roots varying greatly from that of a series of square roots. Hence, before deciding which of these two formulæ is more suited to our purpose as a general basis, it is first necessary to determine whether mean velocities in similar sections and under corresponding inclinations of every degree happen to vary more exactly with the square roots or with the fourth roots. In order to decide this important point, we have selected, from the five hundred observed results given by D'Arcy and Bazin in the 'Recherches Hydrauliques,' thirty-three cases having different inclinations, but similar in other respects; and from a collection of about one hundred fifty observed results, made by ourselves, and taken from the work of Humphreys and Abbot, the collection of Grebenau, the observations of Trechsel, La Ricca, and Legler, as well as our own, we have selected fifty-two cases of similar results having different inclinations. In all we have chosen eighty-five cases that are suited to the purpose, and have compared the observed velocities with the square roots, the cube roots, and the fourth roots of their inclinations. The results are that out of the first set of thirty-three cases, twenty-seven had their velocities varying more nearly with the square roots, five with the cube roots, and one with the fourth root; and out of the second set of fifty-two cases, thirty cases had their velocities varying more nearly with the square roots, nine with the cube roots, and thirteen with the fourth root. It may also be observed, that the whole of the fourteen cases in which the velocities vary more nearly with the fourth root are cases of extremely low inclination, being those of the Mississippi system, the streams

of Grebenau, and one single case of D'Arcy and Bazin. We will hence conclude, that for most falls, with the exception of those that are very low, like that of the Mississippi, the mean velocities in similar sections are more in accordance with the square roots of the sines of the inclinations, and that the simple and useful old-established formula $v = c\sqrt{rs}$ with variable coefficients not only gives good results, but is also in our opinion that most applicable to very varying conditions of inclination.

Assuming therefore the general formula $v = c\sqrt{rs}$ as that most suitable to our purposes, the next matter is to obtain a series of coefficients that will be equally applicable to every degree of inclination that will occur in practice. We have, however, fruitlessly endeavoured to discover any law for the construction of any single set of series of coefficients, that would apply both to the low inclinations of observation of the American, and to the high falls of the Swiss engineers. In plotting the coefficients deduced from these observed results as ordinates to abscissæ representing the inclinations, we discover that the greatest values of the former correspond to the least values of the latter, and the converse, and that no mean curve could be drawn that would be applicable throughout. It is also necessary to remark that the coefficients obtained in the same way for the American formula show a persistent increase of value with the increase of inclination; a proof that that formula gives incorrect results in this respect.

On plotting the former coefficients as ordinates to abscissæ representing values of r, the mean radius, and similarly plotting the curve of the coefficients calculated according to the formulæ of D'Arcy and Bazin, we find that they approximately correspond in cases having similar conditions of section; a confirmation of the correctness of the formulæ of these authors as far as this is concerned.

7. The Variation of the Coefficients c with the Inclination.

Having thus discovered that the coefficients c of the old-established formula generally vary with the inclinations for like values of r in such a manner that their values are greatest for the lowest inclinations, and the converse, let us consider them now solely with reference to the Mississippi observations. Their extreme limits there are

$c = 256$ for an inclination of $0 \cdot 0034$ per thousand,

and

$c = 154$ for an inclination of $0 \cdot 0200$ per thousand;

and if a curve be drawn to represent them, it becomes a reversed hyperbola, whose ordinates decrease with the increase of inclination. It is therefore evident, from the extreme sensitiveness of the coefficients when applied within these limits, that the old formula is in this respect inapplicable to extremely low inclinations, while the new American formula on the contrary is very well suited to them.

This relation of the inclinations to the coefficients c holds good with the highest of the falls on the large rivers of the Mississippi series, but is more fully exemplified when the coefficients diminish with decreasing values of r; so that for cases of smaller rivers it may be accepted that with similar values of r the difference of inclination has so small an influence on the coefficient c that it may be entirely neglected without error.

Since the four formulæ of D'Arcy and Bazin have been found to give good results, not only in accordance with the observed results mentioned in their own work, but also with those collected by ourselves, and since they also, while possessing no exclusive claim to general application, admit of

the interpolation and addition of additional series of coefficients beyond those of their four categories, they may most justly be considered as correct points of departure in an extensive field of variation. We will therefore assume that these formulæ are of practical value to us for the purpose of gradually working out a good and complete series of coefficients.

8. The Employment of the Formulæ of D'Arcy and Bazin in constructing a Series of Coefficients.

The following are the four formulæ for mean velocity of D'Arcy and Bazin, in terms suited to Swiss feet; to each of them is also attached the corresponding expression for the value of c, the coefficient in the general formula, $v = c\sqrt{r\,s}$, which we have taken as a basis. In each case, as before, r is the mean hydraulic radius, and s is the sine of the inclination of the water surface, or fall in a length of unity.

1st *Category.*—Very smooth surfaces of pure cement, or carefully planed timber:

$$v = \sqrt{\frac{r\,s}{0\cdot000\,045 + \dfrac{0\cdot000\,0045}{r}}};$$

$$c = \sqrt{\frac{1}{0\cdot000\,045 + \dfrac{0\cdot000\,0045}{r}}}.$$

2nd *Category.*—Smooth surfaces of cut stone or brickwork, of cement with sand, or of planking:

$$v = \sqrt{\frac{r\,s}{0\cdot000\,057 + \dfrac{0\cdot000\,0133}{r}}};$$

$$c = \sqrt{\frac{1}{0\cdot000\,057 + \dfrac{0\cdot000\,0133}{r}}}.$$

3rd Category.—Less carefully constructed sections in rubble:

$$v = \sqrt{\frac{r\,s}{0{\cdot}000\,072 + \dfrac{0{\cdot}000\,0600}{r}}};$$

$$c = \sqrt{\frac{1}{0{\cdot}000\,072 + \dfrac{0{\cdot}000\,0600}{r}}}.$$

4th Category.—Sections in earth:

$$v = \sqrt{\frac{r\,s}{0{\cdot}000\,084 + \dfrac{0{\cdot}000\,3500}{r}}};$$

$$c = \sqrt{\frac{1}{0{\cdot}000\,084 + \dfrac{0{\cdot}000\,3500}{r}}}.$$

These four expressions indicate a great variation in the values of the terms of the formulæ corresponding to the varieties of quality of the surface. We may hence conclude that the observations of D'Arcy and Bazin prove that the degree of roughness of the wetted perimeter forms a very important influence on the value of the coefficient on small sections of discharge; the respective proportions of these four formulæ also show that this influence decreases with the increase of the sectional area, and, although it never entirely vanishes, is inconsiderable in very large rivers like the Mississippi.

We may also remark, that these four categories admit of the interpolation and addition of a large number of cases of different conditions, and can thus be made to include and produce smaller values of the coefficient c than those afforded by the fourth category; they might then become applicable to the coefficients calculated by ourselves from the observed results on the Aar, and the streams in Canton Graubündten, which are encumbered with detritus.

The necessity and the mode of introducing these interpolated and additional categories, suitable to the cases that occur, will necessárily be partly dependent for exactitude on the correctness and sufficiency of knowledge of the details of the observations; the effect of the various degrees of inclination on the coefficients, previously mentioned, must also be borne in mind.

With reference to the observed results on the Wildbachschale, previously quoted, we may notice that the G'rünnbachschale and Gerbebachschale, whose walling is much damaged, can very well come under the third category. This, however, is not applicable to the more recently constructed Gontenbachschale, which have a better walling than that supposed in the third category, and a worse walling than that of the second. The coefficient c calculated for one of them when $r = 0 \cdot 375$ according to the third formula is 65, and gives too small a mean velocity, while that according to the second formula is 100, which gives too high a mean velocity; the actually correct coefficient being 83, or approximately a mean between the two; the walling of the Gontenbachschale being in point of fact a mean as regards smoothness between rubble and ashlar. We must therefore not overlook the fact that we here require a category of coefficients interpolated at about midway between Categories II. and III., under conditions of section that differ sufficiently from those of either of them to justify its adoption; we must also determine more exactly the conditions of section applicable to these three categories.

With reference to our observed results on rivers and streams whose beds and banks are encumbered with deposit, it is evident they cannot come under Category No. IV. of sections in earth, as Formula No. IV. gives values of coefficients c that are too large for them. This is very natural, as part of the living force of the water is destroyed

by the deposit; the larger the boulders, and the greater the quantity of them obstructing the section of flow, the more will the velocity of the water be reduced. In the formula $\frac{1}{c^2} = \alpha + \frac{\beta}{r}$, which expresses the effect of the roughness, and in which the factors α and β are the divisors in the formulæ of D'Arcy and Bazin, these factors will increase with the size and quantity of the deposit, and may hence vary very much for different cases in the same river: they will increase with high water and with motion of the boulders, and decrease with low water and with their deposition.

For our purposes we shall not go far wrong if we calculate these velocities in channels encumbered with detritus for one single value of r only, and make them correspond to those obtained by Formula IV. for sections in earth with a radius of 0·7; or, which is the same thing, if we calculate our coefficients for this purpose from a formula,

$$c = \sqrt{\frac{1}{0{\cdot}000\,120 + \frac{0{\cdot}000\,7}{r}}},$$

and consider this as the basis of a new or a fifth category of coefficients.

We here attach a table of calculated coefficients resulting from the above five formulæ, which are applicable to all values of r that are likely to occur in practice; and in order to afford a trustworthy guide for their employment, we give also immediately following them a table of practically determined coefficients, obtained by ourselves from direct velocity measurements in a considerable number of cases, together with the calculated coefficients corresponding to them, and the differences between the two. A careful examination of these two collections, and a comparison of the similar cases occurring under similar conditions, will aid us in eventually

determining and adopting a final series of coefficients that will be both correct and sufficiently comprehensive for all practical purposes.

9. Table of Calculated Coefficients applicable to the General Formula $v = c\sqrt{r\,s}$, arranged as to Condition of Section according to the Four Categories of D'Arcy and Bazin, and a Fifth one of the Author.

Explanation.

The quantities given in the three columns, corresponding to all values of r required in practice, are values of the following expressions:

c is the variable coefficient in the formula $v = c\sqrt{r\,s}$.

$c\sqrt{r} = m$ is a variable quantity, dependent on c, useful in obtaining values of v corresponding to different values of $\sqrt{s}$.

$\dfrac{1}{c^2\,r} = n$ is a variable quantity, useful in calculating values of s, when v and r are given, as is shown by putting the formula in the form $s = \dfrac{v^2}{c^2\,r}$.

The quantities are applicable to Swiss feet.

CATEGORY I.

VERY SMOOTH SURFACES OF PURE CEMENT, WELL-PLANED TIMBER, ETC.

$$c = \sqrt{\frac{1}{0\cdot000\,045 + \frac{0\cdot000\,0045}{r}}}.$$

r	c $(v = c\sqrt{r\,s})$	$c\sqrt{r} = m$ $(v = m\sqrt{s})$	$\frac{1}{c^2 r} = n$ $(s = n\,v^2)$
0·01	44·95	4·495	0·0495000
0·05	86·07	19·245	27000
0·1	105·41	33·333	9000
0·2	121·72	54·433	3375
0·3	129·10	70·711	2000
0·4	133·33	84·327	1407
0·5	136·08	96·225	1080
0·6	138·01	106·90	875
0·7	139·44	116·67	735
0·8	140·54	125·71	633
0·9	141·42	134·61	555
1·0	142·13	142·13	495
1·1	142·72	149·69	446
1·2	143·22	156·89	406
1·3	143·65	163·79	373
1·4	144·02	170·40	344
1·5	144·34	176·78	320
1·6	144·62	182·93	299
1·7	144·87	188·89	280
1·8	145·10	194·67	264
1·9	145·30	200·28	249
2·0	145·48	205·74	236
20	148·70	665·00	23
100	149·00	1490·00	2

CATEGORY II.

SMOOTH SURFACES, ASHLAR, BRICKWORK, PLANKING, ETC.

$$c = \sqrt{\frac{1}{0 \cdot 000\,057 + \frac{0 \cdot 000\,013\,3}{r}}}.$$

r	c ($v = c\sqrt{r s}$)	$c\sqrt{r} = m$ ($v = m\sqrt{s}$)	$\frac{1}{c^2 r} = n$ ($s = n v^2$)
0·01	26·85	2·685	0·1387000
0·05	55·64	12·442	64600
0·1	72·55	22·042	19000
0·2	89·98	40·252	6175
0·3	99·34	51·963	3378
0·4	105·26	66·574	2256
0·5	109·37	77·336	1672
0·6	112·39	87·057	1319
0·7	114·71	95·971	1086
0·8	116·54	104·24	920
0·9	118·03	111·98	797
1·0	119·27	119·27	703
1·1	120·33	126·20	628
1·2	121·20	132·76	567
1·3	121·96	139·06	517
1·4	122·65	145·12	475
1·5	123·22	150·91	439
1·6	123·74	156·52	408
1·7	124·20	161·94	381
1·8	124·62	167·20	358
1·9	125·00	172·30	337
2·0	125·34	177·26	318
20	131·69	588·92	29
100	132·30	1323·00	3

CATEGORY III.

MODERATELY WELL-CONSTRUCTED SECTIONS IN RUBBLE, ETC.

$$c = \sqrt{\frac{1}{0{\cdot}000\,072 + \dfrac{0{\cdot}000\,060\,0}{r}}}$$

r	c $(v = c\sqrt{r\,s})$	$c\sqrt{r} = m$ $(v = m\sqrt{s})$	$\frac{1}{c^2 r} = n$ $(s = n\,v^2)$
0·01	12·83	1·283	0·6072000
0·05	30·54	6·830	214400
0·1	38·57	12·199	67200
0·2	51·85	23·187	18600
0·3	60·63	33·210	9067
0·4	67·12	44·448	5554
0·5	72·17	51·031	3840
0·6	76·25	59·063	2867
0·7	79·63	66·624	2253
0·8	82·48	73·771	1837
0·9	84·94	80·582	1540
1·0	87·04	87·039	1320
1·1	88·91	93·251	1150
1·2	90·54	99·177	1017
1·3	92·02	104·92	908
1·4	93·33	110·43	820
1·5	94·49	115·73	747
1·6	95·56	120·88	684
1·7	96·54	125·87	631
1·8	97·45	130·74	585
1·9	98·25	135·43	545
2·0	99·01	140·03	510
20	115·47	516·40	37
100	117·36	1173·63	4

CATEGORY IV.

Sections in Earth.

$$c = \sqrt{\frac{1}{0 \cdot 000\ 084 + \frac{0 \cdot 000\ 350\ 9}{r}}}$$

r	c ($v = c\sqrt{r\,s}$)	$c\sqrt{r} = m$ ($v = m\sqrt{s}$)	$\frac{1}{c^2 r} = n$ ($s = n\,v^2$)
0·1	16·70	5·282	0·0358400
0·2	23·25	10·443	91700
0·3	28·27	15·486	41700
0·4	32·29	20·423	23975
0·5	35·64	25·225	15745
0·6	38·71	29·985	11122
0·7	41·38	34·585	8343
0·8	43·87	39·252	6494
0·9	45·99	43·624	5254
1·0	48·00	48·002	4340
1·1	49·86	52·298	3656
1·2	51·59	56·518	3131
1·3	53·21	60·666	2717
1·4	54·72	64·743	2386
1·5	56·14	68·753	2115
1·6	57·47	72·697	1892
1·7	58·74	76·585	1705
1·8	59·93	80·401	1547
1·9	61·06	84·166	1412
2·0	62·14	87·875	1295
2·1	63·16	91·529	1194
2·2	64·14	95·132	1105
2·3	65·07	98·685	1027
2·4	65·96	102·19	957
2·5	66·81	105·64	896
2·6	67·63	109·05	841
2·7	68·42	112·42	791
2·8	69·17	115·74	746
2·9	69·90	119·03	706
3·0	70·59	122·27	669
3·1	71·26	125·48	635
3·2	71·91	128·64	604
3·3	72·54	131·77	576
3·4	73·14	134·86	550
3·5	73·72	137·92	526
3·6	74·28	140·94	499
3·7	74·83	143·94	483
3·8	75·44	147·07	463
3·9	75·87	149·82	445
4·0	76·36	152·72	427
4·1	76·84	155·59	413
4·2	77·31	158·43	398
4·3	77·76	161·24	385
4·4	78·20	164·03	372
4·5	78·62	166·78	359

r	c $(v = c\sqrt{rs})$	$c\sqrt{r} = m$ $(v = m\sqrt{s})$	$\frac{1}{c^2 r} = n$ $(s = n v^2)$
4·6	78·94	169·32	0·0000348
4·7	79·44	172·22	337
4·8	79·83	174·90	327
4·9	80·21	177·55	317
5·0	80·58	180·19	308
5·1	80·94	182·80	299
5·2	81·30	185·38	291
5·3	81·64	187·95	283
5·4	81·98	190·49	276
5·5	82·30	193·01	268
5·6	82·62	195·51	262
5·7	82·93	198·00	255
5·8	83·33	200·73	248
5·9	83·53	202·92	243
6·0	83·82	205·32	237
6·1	84·10	207·72	232
6·2	84·38	210·10	226
6·3	84·65	212·47	221
6·4	84·91	214·82	217
6·5	85·17	217·15	212
6·6	85·43	219·47	208
6·7	85·67	221·76	203
6·8	85·92	224·00	199
6·9	86·15	226·31	195
7·0	86·39	228·56	191
7·1	86·61	230·79	188
7·2	86·84	233·01	184
7·3	87·06	235·22	181
7·4	87·27	237·40	177
7·5	87·48	239·58	174
7·6	87·69	241·74	171
7·7	87·89	243·89	168
7·8	88·09	246·02	165
7·9	88·28	248·14	162
8·0	88·47	250·24	160
8·1	88·66	252·34	157
8·2	88·85	254·45	154
8·3	89·03	256·48	152
8·4	89·20	258·53	150
8·5	89·38	260·58	147
8·6	89·55	262·61	145
8·7	89·72	264·63	143
8·8	89·89	266·61	141
8·9	90·01	268·54	139
9·0	90·21	270·62	137
9·1	90·37	272·60	135
9·2	90·52	274·56	133
9·3	90·67	276·52	131
9·4	90·81	278·41	129
9·5	90·97	280·39	127
9·6	91·11	282·30	125
9·7	91·26	284·54	124
9·8	91·40	286·12	122
9·9	91·53	288·01	121

r	c ($v = c\sqrt{rs}$)	$c\sqrt{r} = m$ ($v = m\sqrt{s}$)	$\frac{1}{c^2 r} = n$ ($s = nv^2$)
10·0	91·67	289·89	0·0000119
10·1	91·80	291·76	117
10·2	91·94	293·62	116
10·3	92·06	295·47	114
10·4	92·19	297·32	113
10·5	92·32	299·15	112
10·6	92·44	300·97	110
10·7	92·56	302·79	109
10·8	92·68	304·59	108
10·9	92·80	306·39	106
11·0	92·92	308·18	105
11·1	93·04	309·97	104
11·2	93·15	311·74	103
11·3	93·26	313·51	102
11·4	93·37	315·26	101
11·5	93·48	317·01	100
11·6	93·59	318·75	98
11·7	93·70	320·49	97
11·8	93·80	322·21	96
11·9	93·90	323·93	95
12·0	94·00	325·63	94
12·1	94·10	327·33	93
12·2	94·20	329·03	92
12·3	94·30	330·71	91
12·4	94·39	332·40	90
12·5	94·49	334·08	90
12·6	94·58	335·74	89
12·7	94·68	337·40	88
12·8	94·77	339·06	87
12·9	94·86	340·71	86
13·0	94·95	342·35	85
13·1	95·04	343·97	85
13·2	95·12	345·59	84
13·3	95·21	347·21	83
13·4	95·29	348·83	82
13·5	95·38	350·44	81
13·6	95·46	352·04	81
13·7	95·54	353·63	80
13·8	95·62	355·23	79
13·9	95·70	356·81	79
14·0	95·78	358·39	78
14·1	95·87	360·00	77
14·2	95·94	361·52	77
14·3	96·01	363·07	76
14·4	96·09	364·63	75
14·5	96·16	366·18	75
14·6	96·24	367·73	74
14·7	96·31	369·26	73
14·8	96·38	370·79	73
14·9	96·45	372·31	72
15·0	96·53	373·84	72
15·1	96·59	375·35	71
15·2	96·66	376·85	70
15·3	96·73	378·35	70

r	c $(v = c\sqrt{rs})$	$c\sqrt{r} = m$ $(v = m\sqrt{s})$	$\frac{1}{c^2 r} = n$ $(s = nv^2)$
15·4	96·79	379·85	0·0000069
15·5	96·86	381·35	69
15·6	96·93	382·83	68
15·7	97·00	384·33	68
15·8	06	385·81	67
15·9	12	387·28	67
16·0	19	388·75	66
16·1	25	390·21	66
16·2	31	391·67	65
16·3	37	393·12	65
16·4	43	394·57	64
16·5	49	396·02	64
16·6	55	397·46	63
16·7	61	398·88	63
16·8	67	400·33	62
16·9	72	401·74	62
17·0	78	403·16	62
17·1	84	404·58	61
17·2	89	405·99	61
17·3	95	407·40	60
17·4	98·00	408·82	60
17·5	06	410·21	59
17·6	11	411·60	59
17·7	17	413·00	59
17·8	22	414·40	58
17·9	27	415·77	58
18·0	32	417·15	57
18·1	37	418·51	57
18·2	42	419·89	57
18·3	47	421·73	56
18·4	52	422·62	56
18·5	57	423·97	56
18·6	62	425·32	55
18·7	67	426·67	55
18·8	72	428·02	55
18·9	76	429·38	54
19·0	81	430·71	54
19·1	86	432·05	54
19·2	90	433·37	53
19·3	95	434·71	53
19·4	99·00	436·03	53
19·5	04	437·34	52
19·6	08	438·36	52
19·7	13	439·97	52
19·8	17	441·28	51
19·9	21	442·59	51
20·0	26	443·90	51
30	102·24	..	..
40	103·83	..	..
50	104·83	..	..
60	105·51	..	..
70	106·00	..	..
80	106·37	..	..
100	106·90	..	..

CATEGORY V.

FOR SECTIONS COVERED WITH DETRITUS, CORRESPONDING TO THOSE OF THE STREAMS IN CANTON GRAUBÜNDTEN.

$$c = \sqrt{\frac{1}{0{\cdot}000\,120 + \frac{0{\cdot}000\,7}{r}}}$$

r	c	r	c	r	c
0·1	12	3	53	10	73
0·3	20	4	58	13	76
0·5	26	5	62	16	78
1	35	7	67	20	80
2	46				

10. TABLE OF EXPERIMENTAL VALUES OF COEFFICIENTS IN THE FORMULA $v = c\sqrt{rs}$ OBTAINED FROM VELOCITY OBSERVATIONS.

Explanation.

The first three columns give the actual values of r, s, and v, as obtained by measurement; the fourth column gives the value of E, the coefficient resulting from experiment; the columns I. II. III. IV. give values of the corresponding calculated coefficients in these respective categories according to the formulæ of D'Arcy and Bazin; and the last column gives the difference.

The quantities are in Swiss feet.

r	Fall per 1000.	v	Coefficients.					REMARKS.
			E	II.	III.	IV.	Difference.	
			I. SECTIONS IN MASONRY, SEMICIRCULAR.					
			a. Gerbebachschale.					Rather damaged.
0·197	237·3	10·31	58	90	52	..	III + 6	The successive decrements in these coefficients is due to the employment of an average, instead of an exact, value of r.
„	185·2	9·58	55	„	„	..	„ + 0	
„	167·9	9·33	51	„	„	23	„ − 1	
„	137·5	9·05	50	„	„	„	„ − 2	
„	111·7	8·61	48	„	„	„	„ − 4	

r	Fall per 1000.	*v*	Coefficients. E	II.	III.	IV.	Difference.	REMARKS.
			b. G'rünnbachschale.					Rather damaged.
0·394	106·775	13·97	68	105	67		III + 1	Little water, but clear.
0·385	99·270	13·54	69	104	66		„ + 3	
	82·850	12·00	69	103	64		„ + 5	
	106·775	19·48	73		78	40	„ − 5	Turbid water with detritus.
	99·270	18·58	73		78	40	„ − 5	
	82·850	15·79	71		76	39	„ − 5	
			c. Gontenbachschale.					New and well constructed.
0·328	46·425	10·66	86	101	62	..	III + 24, II − 15	It is evident that these are means between Categories I. and II.
„	42·350	9·60	81	101	62	..	„ + 19, „ − 20	
0·375	46·425	11·15	84	104	65	..	„ + 19, „ − 20	
„	42·350	10·05	83	104	65	..	„ + 18, „ − 21	
			d. Mill-leats, Diemerstein.					Section in Sandstone.
3·0	1·40	1·40	70	99	61	..	III + 9	

r	Fall per 1000.	*v*	Coefficients. E	IV.	Difference.	REMARKS.
			II. SECTIONS IN EARTH.			
			a. Brooks, Hübengraben, Hockenbach, Speyerbach, Lautercanal, Canal at Ried von Marmels, Canal in England.			
0·6	1·300	1·45	52	39	IV + 13	The inclinations are generally low. The greatest differences occur with the least inclinations. The sections appear to be better than that allowed for by the formula, with the exception of the last but one, which is evidently strong.
0·9	0·778	1·46	56	46	„ + 10	
0·9	0·797	1·49	56	46	„ + 10	
1·5	0·667	1·85	59	56	„ + 3	
1·6	0·267	1·83	88	57	„ + 31	
1·8	0·664	2·14	61	60	„ + 1	
2·35	0·500	1·92	56	65	„ − 9	
2·50	0·063	1·13	91	67	„ + 24	
			b. Chesapeake Ohio Speisecanal, River Hague, Yssel, Ohio (Point Pleasant), Rhine below the Yssel.			
3·8	0·698	2·72	54	75	IV − 21	In the Chesapeake Ohio Speisecanal there is grass or weeds, and the inclination is high; this is expressed by the coefficients. The remainder have lower inclinations, and hence higher coefficients.
3·9	0·698	3·03	59	76	„ − 17	
5·1	0·165	2·49	87	81	„ + 6	
6·0	0·156	2·56	85	84	„ + 1	
6·2	0·117	2·77	105	84	„ + 21	
7·0	0·093	2·51	100	86	„ + 14	
7·9	0·117	2·92	97	88	„ + 9	

r	Fall per 1000.	v	Coefficients. E	Coefficients. IV.	Coefficients. Difference.	Remarks.
c. The Tiber at Rome, the Rhine at Speyer, Waal, the Rhine at Pannerden, and at Byland.						
9·9	0·131	3·41	97	92	IV + 5	
9·9	0·112	2·96	89	92	„ − 3	
11·5	0·104	3·16	93	93	..	
11·7	0·100	3·28	98	94	„ + 4	
17·1	0·098	3·57	89	98	„ − 9	
d. Bayou Lafourche, Bayou Plaquemine, the Great Newka.						
13·0	0·044	2·79	119	95	IV + 24	Low inclination.
13·6	0·037	2·84	128	95	„ + 33	„ „
16·0	0·144	3·96	84	97	„ − 13	High inclination.
16·3	0·045	3·08	115	97	„ + 18	Low inclination.
16·8	0·036	2·81	129	98	„ + 31	„ „
18·1	0·015	2·05	127	98	„ + 29	„ „
19·1	0·206	5·20	84	99	„ − 15	High inclination.
e. Newa, Mississippi.						
46·4	0·014	3·23	145	102	IV + 43	Low inclination.
32·0	0·022	3·52	130	100	„ + 30	„ „
54·3	0·030	5·56	139	103	„ + 36	„ „
59·8	0·048	6·32	120	103	„ + 17	„ „
66·8	0·064	6·95	108	104	„ + 4	High inclination.
67·3	0·044	6·82	128	104	„ + 24	Low inclination.
68·6	0·068	6·96	103	104	„ − 1	High inclination.
74·4	0·017	5·89	166	105	„ + 61	Slight inclination.
75·1	0·020	5·93	154	105	„ + 49	„ „
77·0	0·003	4·03	253	105	„ +148	Very slight inclination.
78·3	0·004	3·98	234	105	„ +129	„ „ „
f. Linth Canal.						
5·2	0·29	3·47	89	81	IV + 8	The Linth canal has a rather smoother section than that of the Fourth Category. Its coefficients run higher than, but yet tolerably parallel to, those of D'Arcy and Bazin.
6·0	0·30	3·90	92	84	„ + 8	
6·6	0·31	4·22	93	85	„ + 8	
7·2	0·32	4·49	93	87	„ + 8	
7·6	0·33	4·83	96	88	„ + 8	
8·2	0·34	5·00	95	89	„ + 6	
8·4	0·34	5·14	96	89	„ + 7	
8·7	0·35	5·31	96	90	„ + 6	
9·0	0·36	5·48	96	90	„ + 6	
9·3	0·37	5·62	95	91	„ + 4	

r	Fall per 1000.	v	Coefficients.			Remarks.
			E	IV.	Difference.	
			III. Sections obstructed by Detritus.			
			a. Aar.			
3·250	1·27	4·37	68	72	IV − 4	Some of the measurements are doubtful. The influence of the detritus is generally very evident.
4·122	1·09	6·37	95	77	" + 18	
4·769	1·78	5·67	62	80	" − 18	
5·597	1·09	7·38	94	83	" + 11	
6·351	1·27	6·38	71	85	" − 14	
6·900	1·87	5·93	52	86	" − 34	
7·350	1·78	7·05	62	87	" − 25	
8·819	0·14	2·04	58	90	" − 32	
11·855	0·28	3·06	53	94	" − 41	
12·005	0·10	2·30	66	94	" − 28	
15·510	0·10	3·53	90	97	" − 7	
17·526	0·12	4·40	96	98	" − 2	
			b. Escher Canal.			
3·815	3·00	6·46	60	75	IV − 15	The detritus is large.
4·487	3·00	7·80	67	78	" − 11	
4·821	3·00	10·87	90	80	" + 10	?
			c. The Meuse at Misox.			
1·001	11·87	3·93	36	48	IV − 12	Influence of detritus.
1·217	11·87	5·63	47	52	" − 5	" " "
1·550	11·87	7·71	57	57	..	
			d. The Rhine at Domleschgerthal.			
0·255	5·77	1·27	33	26	IV + 7	Some of these results generally indicate the influence of the detritus.
1·073	6·43	3·70	35	48	" − 13	
1·086	6·43	4·38	52	49	" + 3	
1·128	6·43	4·60	54	50	" + 4	
1·335	6·43	5·13	55	54	" + 1	
1·329	6·43	5·24	57	54	" + 3	
1·344	7·73	4·83	45	54	" − 9	
1·320	7·96	7·00	59	53	" + 6	
1·366	7·73	3·91	38	54	" − 16	
2·000	7·73	5·97	43	62	" − 19	
1·970	7·96	7·20	55	62	" − 7	
2·227	7·03	6·77	76	64	" + 12	
2·429	7·73	6·07	44	66	" − 22	
2·465	7·96	7·40	52	66	" − 14	
2·997	7·55	7·25	48	70	" − 22	
2·997	7·75	7·40	49	70	" − 21	
2·997	7·96	7·54	49	70	" − 21	
3·110	7·03	8·38	57	71	" − 14	
3·195	7·96	8·83	52	72	" − 20	
3·475	7·96	9·67	56	73	" − 17	

r	Fall per 1000.	v	Coefficients. E	IV.	Difference.	REMARKS.
			e. The Plessur at Thur.			
1·267	9·65	6·10	55	53	IV + 2	These results agree well generally, with the exception of two.
2·373	9·65	10·15	67	66	„ + 1	
3·531	9·65	10·36	56	73	„ − 17	
3·638	9·65	13·80	74	74	..	
3·650	9·65	14·17	75	75	..	
4·365	9·65	13·07	68	78	„ − 10	
			f. The Rhine at Rheinwald.			
0·423	14·20	2·37	31	33	IV − 2	
0·776	14·20	4·60	44	43	„ + 1	
1·229	14·20	6·13	46	52	„ − 6	

11. REMARKS ON THE SERIES OF OBSERVATIONS OF D'ARCY AND BAZIN.

The 'Recherches Hydrauliques' of D'Arcy and Bazin contain fifty series, comprising three hundred and seventy measured observations of cases similar to the foregoing, which afford a large number of experimentally obtained coefficients c for the formula $v = c\sqrt{r\,s}$. We have plotted them to scale according to their respective categories, in conjunction with the curves of the coefficients calculated from the four formulæ; they indicate the following results:

Category I.—Very smooth Sections in Cement, planed Timber, etc.

The coefficients afforded by the series Nos. 2, 24, 25, 28, and 29, group themselves generally close to the calculated coefficients obtained by formula No. I.; in the semicircular sections in cement, series Nos. 24 and 25, the coefficients are higher than those of the formula, and increase very rapidly with the values of r.

Category II.—Sections in Ashlar, Brickwork, and Planking, etc.

The coefficients given by fifteen series agree very well with the curve of coefficients corresponding to formula No. I.; but the sections in plank show greater variability than those in stone, more especially those that are of a semicircular form. The results of the above very varied constructions of section show that the coefficients that correspond to rectilinear sections do not vary much.

Category II. to III.—Sections rougher than Ashlar, Brickwork, and Planking, but smoother than dry Rubble.

This new category adopted by ourselves, and placed as an arithmetic mean between Categories II. and III., is not mentioned by D'Arcy and Bazin. The necessity of this new category as a special class is, however, clearly shown from the examination of series Nos. 12, 13, 14, 27, 30, and 31, as well as those of the Gontenbachschale at Lake Thun. The series Nos. 12, 13, and 14 are rectangular sections in planking, the planks being 0·09 foot wide, placed 0·033 foot apart: series No. 27 is a semicircular section of firmly punned gravel 0·03 to 0·07 foot thick; the Gontenbachschale is also semicircular, but is made of new and well-constructed large dry rubble. In both sections the derived coefficients fall in a mean curve lying midway between those of Categories II. and III. The series Nos. 30 and 31 have very small sections of plank covered with canvas, and give coefficients which fall between those of formula No. II. and those of the new class midway between Categories II. and III.; they may hence be almost considered as belonging to Category No. II.

Category III.—Ordinary dry Rubble.

To this category belong series Nos. 4, 32, 33, 45, as well as those of the G'rünnbachschale and the Gerbebachschale at Merligen on Lake Thun, which are semicircular in section and much damaged.

Category III. to IV.—Worse than ordinary Rubble and better than Earthen Sections, being an arithmetic mean between Categories III. and IV.

This class is not proposed by D'Arcy and Bazin, but is a natural result of the examination of the following series: Series No. 5, rectangular, made of well punned gravel 0·10 to 0·15 foot thick; series Nos. 15, 16, and 17, sections in planks, nailed on transversely, 0·09 foot broad and 0·167 foot apart; series No. 35, bad masonry; series Nos. 44 and 46, rectangular, of damaged masonry, having their beds covered with stones and mud; lastly, the Alpbachschale at Meiringen, of old and very much damaged rubble.

Category IV.—Sections in Earth.

To this belong series Nos. 34, 37, 38, 41, 42, 47, 48, 49, and 50. Some of these are entirely in earth, without any vegetation on the bed or banks; some of bad masonry, covered with moss and plants, or having their beds covered with stones and mud; some rocky sections, etc. To this category also approximately belong a large number of observations on the Seine, Saone, Hayne, Canal du Jard, as well as those of the Swiss, and those of the American engineers on the Mississippi and its tributaries.

Category V.—Sections obstructed by Detritus.

This is not one of D'Arcy and Bazin's categories, but is the result of observations on rivers having their beds and banks obstructed by detritus, principally those of La Ricca, Legler, etc. To this class belong series Nos. 36, 40, and 43, in the sections of which occur many plants, grass, rocks, and stone strewn about.

The determination of the final coefficients for all these classes will be subsequently explained. Further reference as to the observations of D'Arcy and Bazin may be made by consulting their 'Recherches Hydrauliques;' the remaining observations we have already given in the table at pages 25 and 26, paragraph 10.

12. The Coefficients of D'Arcy and Bazin for calculating Mean from Maximum Velocities.

The numerous and accurate observations of D'Arcy and Bazin have demonstrated that the ratio of mean to maximum velocity in any section, till lately believed to be from 0·80 to 0·83, is not a constant quantity, but a variable one, a fact also noticed by others. Their formula for calculating mean from maximum velocities is as follows:

$$\frac{v_s}{v_m} = 1 + 25 \cdot 56 \sqrt{\frac{r s}{v_m^2}}\,; \text{ or } v_s - v_m = 25 \cdot 56 \sqrt{r s}$$

where v_s is the maximum velocity, and v_m is the mean velocity. The following table of coefficients for calculating mean from maximum velocities, in the four categories, and corresponding to various values of r in Swiss feet, may be found useful. With reference to this subject it may be noticed that in a water-section of small depth the maximum velocity is at the surface, while in one of great depth it is below it; and that in a section of equal breadth and depth, the maximum velocity is at half the depth.*

* See 'Récherches Hydrauliques,' p. 152.

13. Table of the Coefficients of D'Arcy and Bazin for calculating Mean from Maximum Velocities; being Values of the Ratio $\frac{v_m}{v_s}$ as previously explained.

r	Category I.	Category II.	Category III.	Category IV.
0·1	0·80	0·74	0·62	..
0·2	0·83	0·78	0·67	0·51
0·3	0·83	0·79	0·70	0·54
0·4	0·84	0·80	0·72	0·56
0·5	0·84	0·81	0·74	0·58
0·6	0·84	0·81	0·75	0·60
0·7	0·84	0·82	0·76	0·62
0·8	0·85	0·82	0·76	0·63
0·9	0·85	0·82	0·77	0·64
1	0·85	0·82	0·77	0·65
2	0·85	0·83	0·80	0·71
3	..	..	0·80	0·74
4	..	..	0·80	0·75
5	..	..	0·81	0·76
6	..	..	0·81	0·77
7	..	..	..	0·77
8	..	..	..	0·78
9	..	..	..	0·78
10	..	..	..	0·78
11	..	..	..	0·78
12	..	..	..	0·79
20	..	..	..	0·79

14. Examples explanatory of the Use of the Table of Coefficients of D'Arcy and Bazin, given at pages 14 to 22.

(Swiss feet are used in these examples, as well as in the table.)

Example 1. A channel of trapezoidal section with side slopes of 45° and an inclination, $s = 0 \cdot 0008$, has to discharge 5 cubic feet per second at maximum, when the surface of the water will stand at 1 foot below the surface of the ground; the soil is loam, with one-third sand: what will the bottom width be, and what the depth of excavation?

The method of approximation is best suited to this case. The formula to be used is $v = c\sqrt{rs}$.

Assume as a first approximation a bottom width of 3 feet, and a depth at high water of 1 foot. Then the cross section will be 4 square feet, and the wetted perimeter will $= 3 + 2\sqrt{2} = 5 \cdot 8$, and r will $= \dfrac{4}{5 \cdot 8} = 0 \cdot 69$; the coefficient c corresponding to this value of r in Category IV. is $41 \cdot 11$, but as the soil is loamy and tolerably smooth we may take it as 42.

Applying these values in the formula we obtain

$$v = 42\sqrt{0 \cdot 69 \times 0 \cdot 0008} = 0 \cdot 987$$

and $q = 4 \times 0 \cdot 987 = 3 \cdot 95$ cubic feet per second instead of 5 cubic feet per second.

In order to correct this, either the bottom width or the depth of wetted section must be increased; the latter mode is preferable, on account of its occupying a smaller breadth of land.

Assuming therefore for a second approximation a depth of $1 \cdot 3$ feet, the cross section becomes $(3 + 1 \cdot 3) \times 1 \cdot 3 = 5 \cdot 59$ square feet, the wetted perimeter $3 + 2\sqrt{2 \cdot 6} = 6 \cdot 2$, r will $= 0 \cdot 9$, and c in Category IV. will $= 46$:

hence $\qquad v$ will $= 46\sqrt{0 \cdot 9 \times 0 \cdot 0008} = 1 \cdot 24$,

and $\quad q$ will $= 1 \cdot 24 \times 5 \cdot 59 = 6 \cdot 93$ cubic feet per second.

As in the first approximation the discharge resulting from a depth of 1 foot was 1 cubic foot per second too little, and in the second, that from a depth of $1 \cdot 3$ feet was $1 \cdot 93$ cubic feet per second too much, we cannot be far wrong in putting the correct depth at $1 \cdot 1$ feet, the bottom width as 3 feet; and then the depth of excavation will be $2 \cdot 1$ feet.

Example 2. Obtain the bottom width and depth of a planked rectangular channel, which will have maximum discharge of 3·5 cubic feet per second, with an inclination of 0·001.

Assume for a first approximation a bottom width of 2 feet, and a depth of 1 foot.

Then the cross section = 2 square feet, the wetted perimeter = 4 feet, hence r = 0·5 foot, and c in Category II. will be 110.

Therefore

$$v = 110\sqrt{0\cdot5 \times 0\cdot001} = 2\cdot46 \text{ feet per second}$$

and

$$q = 2\cdot46 \times 2 = 4\cdot92 \text{ cubic feet per second.}$$

For a second approximation reduce the bottom width to 0·7 foot; the new quantities resulting are then, the cross section = 1·4 square feet, the wetted perimeter = 3·4 feet, r = 0·41, and c = 105, hence

$$v = 105\sqrt{0\cdot41 \times 0\cdot001} = 2\cdot13, \text{ and } q = 2\cdot13 \times 1\cdot4 = 2\cdot93.$$

In the first case the discharge was 1·4 cubic feet too much, and in the second 0·52 too little; if then we assume a correct depth of 0·8 instead of 1·0 and 0·7 foot, the error will be very small. The sides of the channel will then be not more than 1 foot in height.

Example 3. To calculate the discharge of a channel.

a. The maximum discharge obtained by repeated observations with floats is 5·27 cubic feet per second; the section taken as a mean of those at the two ends and at the middle of the length of channel under observation, is 210 square feet, and the mean wetted perimeter is 57·5 feet.

Hence

$$r = \frac{210}{57\cdot5} = 3\cdot65.$$

The mean velocity is obtained from the maximum by applying a coefficient of reduction, given in the last table, of 0·75.

Hence

$$v = 0\cdot75 \times 5\cdot27 = 3\cdot95,$$

and

$$q = 3\cdot95 \times 210 = 829\cdot5 \text{ cubic feet per second,}$$

or in round numbers 830.

b. If the inclination and dimensions of the channel are given, let the cross section be taken as 117 square feet, the wetted perimeter at 32 feet; and the inclination as $S = 0\cdot000753$; then will $r = 3\cdot656$, and c the coefficient will in Category IV. be 74·6.

Hence

$$v = 74\cdot6 \sqrt{3\cdot656 \times 0\cdot000753}$$
$$= 74\cdot6 \times 0\cdot0525 = 3\cdot92 \text{ feet per second,}$$

and

$$q = 3\cdot92 \times 117 = 458\cdot6 \text{ cubic feet per second,}$$

or in round numbers 460.

Example 4. What is the inclination to be given to a channel, having a maximum discharge of 3 cubic feet per second, that has to be conducted down sloping ground of a soil not allowing of a mean velocity of water of more than 3 feet per second?

Let the section be trapezoidal with side slopes of 1 to one, its bottom width 3 feet, and its depth 1 foot.

Then the cross section will be 4 square feet, the wetted perimeter 5·8 feet; and r will $= 0\cdot69$, and the coefficient n for Category IV. will be 0·000 862 1, and hence $S = n v^2 = 0\cdot000\,862\,1 \times 9 = 0\cdot0077$.

The suggestions afforded by these examples will aid in the choice of coefficients for various cases.

15. The Formulæ and Categories of Gauckler.

The two new formulæ of G. Ph. Gauckler, Engineer of the Ponts et Chaussées and the works on the Rhine at Colmar, are given in a treatise, 'Études Theoriques et Pratiques sur l'Écoulement et le Mouvement des Eaux,' in the Comptes Rendus of the Académie des Sciences. They are:

1st. For inclinations exceeding 0·0007, $\sqrt{v} = \alpha \sqrt[3]{r} \sqrt[4]{s}$.

2nd. For inclinations less than 0·0007, $\sqrt[4]{v} = \beta \sqrt[3]{r} \sqrt[4]{s}$.

These two equations may be reduced to the forms

$$v = \alpha^2 \sqrt[6]{r} \sqrt{r\,s},$$

$$v = \beta^4 \sqrt[3]{r^4\,s}.$$

Mons. Gauckler, from a comparison of the observations of D'Arcy and Bazin, Dubuat, Woltmann, Brünings, Poirée, Emmery, and Léveillé, determines the values of α and β to be as follows in different sections, according to his six Categories for Swiss feet.

Categories.	Values of α	Values of β
1. Ashlar and cement	10·4 to 12·2	7·7 to 8·1
2. Ordinary good masonry	9·3 „ 10·4	7·2 „ 7·7
3. Sections with masonry side walls and the bottom in earth	8·3 „ 9·3	7·0 „ 7·2
4. Canals entirely in earth	7·0 „ 8·3	6·3 „ 7·0
5. Canals in earth, with grass on the sides	6·1 „ 7·0	6·0 „ 6·3
6. Rivers	..	5·8 „ 6·0

First as regards Gauckler's first formula: If we calculate a series of coefficients c for the general formula $v = c\sqrt{rs}$ from those given by Gauckler, for all his six categories, and for a series of values of r, and plot them to the same scale as

the corresponding coefficients of D'Arcy and Bazin, we find that the limits of the former are much greater than those of the latter; for instance, for a value of $r = 2$, the coefficients of Gauckler's first formula vary between ·42 and 168, and those of Bazin between 62 and 145. We also notice that for very small values of r, in the first category the coefficients of D'Arcy and Bazin are higher than those of Gauckler, while in the last category they are lower, and that in the first category the successive increments of c generally rise more steadily according to Gauckler than according to D'Arcy and Bazin, while in the last category, and especially from $r =$ 0·01 to 0·02, they first decrease more rapidly, and afterwards increase more slowly than those according to D'Arcy and Bazin. We give here following the calculated coefficients of Gauckler for his six categories obtained from his first formula for Swiss feet.

Secondly, as regards Gauckler's second formula, suited to streams having inclinations less than 0·0007, where $\sqrt[4]{v} = \beta \sqrt[3]{r} \sqrt[4]{s}$. We have calculated a large number of values of the coefficient β from the results of observation, and find that they correspond tolerably well with the Series Nos. 41 to 50 of D'Arcy and Bazin; while on the contrary the values of β are from 5·3 to 5·4, or less than the minimum fixed by Gauckler at 5·8, for the observations on the Rhine at Germersheim of Grebenau, for those on the Linth canal, Nos. 5 to 10 of Legler, and for those on the Mississippi and its affluents in cases where the inclinations are considerable: again, when the inclinations on the Mississippi are small the values of β increase and reach 7·8.

16. TABLE OF COEFFICIENTS a FOR THE FIRST FORMULA OF GAUCKLER, IN HIS SIX CATEGORIES, ADAPTED TO SWISS FEET.

r	1. $a =$ 10·389 to 12·222	2. $a =$ 9·289 to 10·389	3. $a =$ 8·311 to 9·289	4. $a =$ 6·966 to 8·311	5 and 6. $a =$ 6·111 to 6·966
0·05	66 to 91	52 to 66	42 to 52	29 to 42	23 to 29
0·1	74 „ 102	59 „ 74	47 „ 59	33 „ 47	25 „ 33
0·2	83 „ 114	66 „ 83	53 „ 66	37 „ 53	29 „ 37
0·3	88 „ 122	71 „ 88	57 „ 71	40 „ 57	31 „ 40
0·4	93 „ 128	74 „ 93	59 „ 74	42 „ 59	32 „ 42
0·5	96 „ 133	77 „ 96	61 „ 77	43 „ 61	33 „ 43
0·6	99 „ 137	79 „ 99	63 „ 79	45 „ 63	34 „ 45
0·7	102 „ 141	81 „ 102	65 „ 81	46 „ 65	35 „ 46
0·8	104 „ 144	83 „ 104	67 „ 83	47 „ 67	36 „ 47
0·9	106 „ 147	85 „ 106	68 „ 85	48 „ 68	37 „ 48
1·0	108 „ 149	86 „ 108	69 „ 86	49 „ 69	37 „ 49
1·25	112 „ 155	90 „ 112	72 „ 90	50 „ 72	39 „ 50
1·50	115 „ 160	92 „ 115	74 „ 92	52 „ 74	40 „ 52
1·75	118 „ 164	95 „ 118	76 „ 95	53 „ 76	41 „ 53
2·0	121 „ 168	97 „ 121	78 „ 97	54 „ 78	42 „ 54
2·5	126 „ 174	101 „ 126	80 „ 101	57 „ 80	44 „ 57
3	130 „ 179	104 „ 130	83 „ 104	58 „ 83	45 „ 58
4	136 „ 188	109 „ 136	87 „ 109	61 „ 87	47 „ 61
5	141 „ 195	113 „ 141	90 „ 113	63 „ 90	49 „ 63
7	149 „ 207	119 „ 149	96 „ 119	67 „ 96	52 „ 67
10	158 „ 219	127 „ 158	101 „ 127	71 „ 101	55 „ 71
15	170 „ 235	135 „ 170	108 „ 135	76 „ 108	59 „ 76
20	179 „ 246	142 „ 179	114 „ 142	80 „ 114	62 „ 80

17. THE FORMATION OF A NEW AND FINAL SET OF TWELVE CLASSES, INSTEAD OF THE PREVIOUS CATEGORIES.

The fifty series of observations mentioned in Bazin's work comprise only a very small number of values of r, to which a moderate number of curves or equations are applicable. The same is the case, but in a higher degree, with the observations of Dubuat, Woltmann, Brünings, Poirée, Emmery, etc. Hence we may observe that the formulæ of Gauckler may with an extension of the values of a and β give quite as good results as those of D'Arcy and Bazin, and perhaps even better, as they are more comprehensive and include the

extreme values of r. A series of coefficients however that are obtained directly from observed results of all degrees and conditions are far more useful and comprehensive; they are of more value to the practical engineer, as they possess an exactitude dependent entirely on the correctness of the observations, and at the same time offer to the scientific an opportunity for deriving theoretical deductions that may be quite as correct as any hitherto made.

Such a series of working coefficients c for the formula $v = c\sqrt{r\,s}$ adapted to Swiss feet, as are all the foregoing tables, are given in the following table.

They are separated into twelve new classes, in accordance with the various conditions under which the observations were made, and are dependent on the observations given in Series Nos. 1 to 50 of D'Arcy and Bazin, those of Dubuat, Poirée, Emmery, Léveillé, Funk, Brünings, Woltmann, and Bonati; also given in the 'Recherches Hydrauliques,' as well as others taken from the collection of Grebenau, and on the observations of engineers in Switzerland. These observations are referred to their respective classes in the following list.

From the evident incompleteness and deficiency for our purposes of this collection of observed results, it would be highly desirable to increase it by many more; more especially for the case of rivers and channels impeded by detritus.

18. The New Classes of Coefficients.

The series referred to are those of D'Arcy and Bazin.

Class I. Well-planed timber planks $\frac{1}{3}$ foot wide; rectangular.

Section, Series Nos. 28 and 29. Pure cement, semicircular.

Section, Series No. 24.

Class II. Pure cement, rectangular section, Series No. 2.

Cement with one-third fine sand from the Saone, semicircular section. Series No. 25.

Class III. Planking, semicircular section, Series No. 26.

Class IV. Planking, mill-leats, rectangular, trapezoidal and triangular in section. Series Nos. 6, 7, 8, 9, 10, 11, 18, 19, 20, 21, 22, and 23.

In these the coefficients c increase with the inclinations, which vary from 0·001 487 to 0·008 433.

Class V. Small channels in ashlar and brickwork, rectangular sections. Series Nos. 1 (Baumgarten), 3, and 39.

Class VI. Planks covered with canvas, $\frac{1}{3}$ foot wide, rectangular sections. Series Nos. 30 and 31. Planking of laths 0·09 foot wide, nailed at distances apart of 0·033 foot, rectangular sections. Series Nos. 12, 13, and 14.

In these the coefficients c increase with the decrease of inclination. Well-punned gravel, $\frac{1}{3}$ to $\frac{2}{3}$ inch thick, semicircular section. Series No. 27.

Good dry rubble, semicircular section. Gontenbachschale at Lake Thun,

Class VII. Well-punned gravel, $\frac{1}{3}$ to inch thick, rectangular section. Series No. 4.

Rubble in cement, with the bed damaged and covered with mud, rectangular section. Series Nos. 32 and 33.

Good masonry in a well-constructed section, rectangular. Series No. 45.

Dry rubble of dressed stone, damaged, semicircular section. G'rünnbachschale and Gontenbachschale, at Lake Thun.

Class VIII. Well rammed gravel, 1 to $1\frac{1}{2}$ inches thick, rectangular section. Series No. 5.

Dry rubble, in bad condition, trapezoidal section. Series No. 35.

Masonry, damaged, with the bottom covered with stones and silt, rectangular section. Series Nos. 44 and 46.

Planking, with boards 0·09 foot broad, nailed at distances of $1\frac{2}{3}$ inches apart; rectangular section. Series Nos. 15, 16, and 17.

Here the coefficients c increase with the decrease of inclination.

Dry rubble, old and much damaged, semicircular section. Alpbachschale at Meiringen.

Class IX. Small channels in earth, partly stony soil with a few plants, and partly muddy and covered with grass. Series Nos. 37, 38, 41, 47, 48, 49, and 50.

Masonry, in bad condition, with moss and weeds. Series Nos. 34 and 42.

Class X. Small channels in earth, with plants and grass, and strewn with stones. Series Nos. 36, 40, and 43.

Class XI. Streams and rivers. Baumgarten's observations forming Series Nos. 1, and 41 to 50. Those of Poirée and Emmery on the Seine, of Léveillé on the Saone, of Dubuat on the Jard and Hayne, of Funk on the Weser, of Brünings on the branches of the Rhine, of Woltmann (3 ?), of Bonati, etc., on the Po and Tiber, of Legler on the Linth canal, of Grebenau on streams and on the Rhine in Bavaria, of Humphreys and Abbot on the Mississippi and its affluents, of Destrem on the Great Newka and Neva, etc.

In these cases the coefficients c increase with the decrease of the inclination.

Class XII. Channels of rivers and canals impeded by detritus. Observations of La Ricca on the Rhine at Domleschgerthal and Rheinwald, on the Meuse at Misox, on the Plessur at Thur, and those of Legler on the Escher canal.

19. Table showing the Range of

r	I.	II.	III.	IV.	V.	VI.
0·02	..	..	..	..	..	..
0·02	76	..	..	..	..	30
0·045	..	..	..	..	..	..
0·050	90	..	..	..	..	46
0·06	..	..	..	..	..	..
0·075	100	..	..	..	..	55
0·08	..	..	..	..	..	..
0·10	106	..	..	..	..	61
0·12	..	..	..	..	..	..
0·14	..	..	..	76 to 95	..	..
0·16	126	..	..	79 „ 98	..	68
0·18	..	..	..	81 „ 100	..	..
0·20	130	117	..	83 „ 103	87	72
0·22	..	..	..	84 „ 105	..	..
0·24	..	..	..	86 „ 107	..	..
0·26	136	121	..	88 „ 109	..	76
0·28	..	..	..	89 „ 110	..	..
0·30	..	124	..	90 „ 111	94	79
0·32	..	..	..	92 „ 112	..	..
0·34	..	..	..	93 „ 114	..	..
0·36	..	..	..	94 „ 115	..	82
0·38	..	..	..	95 „ 116	..	..
0·40	136	129	109	96 „ 116	99	85
0·42	..	..	..	98 „ 117	..	..
0·44	..	..	..	99 „ 118	..	..
0·46	..	..	..	100 „ 118	..	87
0·48	..	..	..	100 „ 119	..	..
0·50	140	133	113	101 „ 120	103	89
0·55	..	..	..	103 „ 121	..	91
0·60	144	136	117	106 „ 122	107	93
0·65	..	..	..	107 „ 123	..	95
0·70	148	139	120	108 „ 124	111	96
0·75	..	..	..	110 „ 126	..	98
0·80	152	142	123	111 „ 127	114	99
0·85	..	..	..	112 „ 128	..	100
0·90	156	145	126	113 „ 128	117	101
0·95	..	..	..	114 „ 129	..	102
1·00	159	148	128	114 „ 130	121	103
1·10	162	150	130	..	124	105
1·20	165	152	132	..	127	107
1·30	..	..	..	..	130	..
1·40	..	..	..	..	133	..
1·50	..	..	..	..	136	..
1·60	..	..	..	..	139	..
1·70	..	..	..	..	142	..
1·80	..	..	..	..	145	..
1·90	..	..	..	..	148	..
2·00	..	..	..	..	151	..

OBSERVED COEFFICIENTS. (For Swiss feet.)

VII.	VIII.	IX.	X.	r	XI.	XII.
..	..	..	..	0·25	..	25 to 33
..	..	..	..	0·50	..	30 „ 42
..	..	..	..	0·75	..	33 „ 49
..	..	..	..	1·00	42 to 58	35 „ 54
..	..	..	..	1·5	..	39 „ 61
..	..	..	..	2·0	54 to 70	42 „ 66
..	..	..	..	2·5	..	44 „ 69
..	..	..	..	3·0	63 to 78	47 „ 72
..	..	..	..	3·5	..	49 „ 74
..	..	..	..	4·0	69 to 84	51 „ 77
..	..	..	..	4·5	..	53 „ 79
..	..	..	..	5	73 to 88	54 „ 81
57	38 to 52	..	..	6	76 „ 92	..
..	..	..	..	7	78 „ 95	..
..	..	..	..	8	81 „ 97	..
61	..	..	..	9	82 „ 99	..
..	..	..	..	10	84 „ 101	..
65	42 to 58	..	..	11	85 „ 102	..
..	..	..	..	12	86 „ 103	..
..	..	..	..	13	87 „ 104	..
68	..	..	..	14	88 „ 106	..
..	..	..	..	15	89 „ 107	..
71	46 to 63	..	..	16	90 „ 108	..
..	..	..	..	17	91 „ 108	..
..	..	..	..	18	91 „ 109	..
73	..	..	..	19	92 „ 110	..
..	..	..	..	20	92 „ 111	..
75	49 to 66	..	..	21	93 „ 111	..
77	..	..	..	22	93 „ 112	..
78	52 to 70	..	..	23	94 „ 113	..
79	..	..	..	24	94 „ 113	..
80	54 to 72	..	..	..	..	..
81	..	..	..	..	..	..
82	56 to 74	35 to 51	..	..	..	..
84	..	..	..	..	..	..
85	59 to 77	37 to 53	..	..	..	..
86	..	..	..	..	..	..
87	61 to 79	39 to 55	28 to 41	..	..	..
88	64 „ 81	41 „ 57	29 „ 43	..	..	..
90	66 „ 83	43 „ 58	30 „ 44	..	..	..
91	67 „ 84	45 „ 60	31 „ 46	..	..	..
92	69 „ 85	47 „ 62	33 „ 47	..	..	..
93	71 „ 87	49 „ 64	34 „ 48	..	..	..
94	72 „ 88	50 „ 65	35 „ 50	..	..	..
95	73 „ 90	52 „ 67	36 „ 51	..	..	..
96	75 „ 91	53 „ 69	37 „ 52	..	..	..
97	76 „ 92	55 „ 70	38 „ 53	..	..	..
98	77 „ 93	56 „ 72	38 „ 54	..	..	..

20. Determination of the Final Coefficients for the Twelve New Classes in Metrical Measures.

The four formulæ of D'Arcy and Bazin have the form:

$$v = \sqrt{\frac{r\,s}{a + \frac{\beta}{r}}},$$

while the general formula we have adopted as a basis is

$$v = c\sqrt{r\,s},$$

in which the coefficient c would be, according to D'Arcy and Bazin,

$$c = \sqrt{\frac{1}{a + \frac{\beta}{r}}},$$

in which the values of a and β for Swiss feet are

In Category I. $a = 0{\cdot}000\ 045,\quad \beta = 0{\cdot}000\ 004\ 5;$
" II. $a = 0{\cdot}000\ 057,\quad \beta = 0{\cdot}000\ 013\ 3;$
" III. $a = 0{\cdot}000\ 072,\quad \beta = 0{\cdot}000\ 060\ 0;$
" IV. $a = 0{\cdot}000\ 084,\quad \beta = 0{\cdot}000\ 350\ 0;$

and in our new Category V.

$$a = 0{\cdot}000\ 120,\quad \beta = 0{\cdot}000\ 700\ 0.$$

These quantities (a and β) being in all cases small and inconvenient, the formula may be improved by putting it into another form.

Reducing the expression $\frac{1}{a + \frac{\beta}{r}}$, it becomes

$$= \frac{1}{a} - \frac{\frac{1}{a} \times \frac{\beta}{r}}{a + \frac{\beta}{r}} = \frac{1}{a} - \frac{\frac{\beta}{a\,r}}{\frac{a\,r + \beta}{r}}$$

$$= \frac{1}{a} - \frac{\frac{\beta}{a}}{a\,r + \beta} = \frac{1}{a} - \frac{\frac{\beta}{a^2}}{r + \frac{\beta}{a}};$$

and putting $\frac{1}{\alpha} = a$, and $\frac{1}{\beta} = b$, it becomes

$$= a - \frac{a\,b}{r + b},$$

and

$$c = \sqrt{a - \frac{a\,b}{r + b}}.$$

The values of c in each of the above categories for Swiss feet then become as follows, both in exact and in simplified round numbers:

In Category I.

$$c = \sqrt{22\,222 - \frac{2222}{r + 0{\cdot}1}} \text{ or } \sqrt{22\,000 - \frac{2200}{r + 0{\cdot}1}}.$$

In Category II.

$$c = \sqrt{17\,544 - \frac{4093}{r + 0{\cdot}2333}} \text{ or } \sqrt{18\,000 - \frac{3600}{r + 0{\cdot}2}}.$$

In Category III.

$$c = \sqrt{13\,899 - \frac{11\,574}{r + 0{\cdot}8333}} \text{ or } \sqrt{14\,000 - \frac{11\,200}{r + 0{\cdot}8}}.$$

In Category IV.

$$c = \sqrt{11\,905 - \frac{49\,603}{r + 4{\cdot}1666}} \text{ or } \sqrt{12\,000 - \frac{48\,000}{r + 4}}.$$

In Category V.

$$c = \sqrt{8333 - \frac{48\,611}{r + 5{\cdot}8333}} \text{ or } \sqrt{8000 - \frac{48\,000}{r + 6}}.$$

The following is also a corresponding reduction and simplification of the same coefficients for metrical measures:

Category I.

$$c = \sqrt{\frac{1}{0{\cdot}000\,15 + \frac{0{\cdot}000\,004\,5}{r}}} = \sqrt{6667 - \frac{200}{r + 0{\cdot}03}}.$$

Category II.

$$c = \sqrt{\frac{1}{0{\cdot}000\,19 + \dfrac{0{\cdot}000\,013\,3}{r}}} = \sqrt{5286 - \frac{370}{r + 0{\cdot}07}}.$$

Category III.

$$c = \sqrt{\frac{1}{0{\cdot}000\,24 + \dfrac{0{\cdot}000\,060\,0}{r}}} = \sqrt{4160 - \frac{1040}{r + 0{\cdot}25}}.$$

Category IV.

$$c = \sqrt{\frac{1}{0{\cdot}000\,28 + \dfrac{0{\cdot}000\,350\,0}{r}}} = \sqrt{3568 - \frac{4460}{r + 1{\cdot}25}}.$$

Category V.

$$c = \sqrt{\frac{1}{0{\cdot}000\,40 + \dfrac{0{\cdot}000\,070\,0}{r}}} = \sqrt{2500 - \frac{4375}{r + 1{\cdot}75}}.$$

The values of these expressions corresponding to different values of r, for metrical measures, are given in the following table:

r	I.	II.	III.	IV.	V.	r	I.	II.	III.	IV.	V.
0·01	40·8	25·7	12·6	5·3	3·8	0·8	80·2	69·6	56·3	37·3	28·0
0·03	57·7	39·7	21·1	9·2	6·5	0·9	80·3	69·9	57·1	38·7	29·1
0·05	64·6	46·8	26·4	11·7	8·3	1	80·4	70·1	57·7	39·8	30·1
0·07	68·3	51·3	30·2	13·8	9·8	2	..	..	..	46·9	36·5
0·10	71·6	55·6	34·5	16·3	11·6	3	..	..	..	50·2	39·7
0·15	74·5	59·9	39·5	19·6	14·0	4	..	..	..	52·2	41·7
0·2	76·1	62·4	43·0	22·2	16·0	5	..	..	..	53·5	43·0
0·3	77·9	65·3	47·7	26·3	19·1	6	..	..	..	54·4	44·0
0·4	78·8	66·9	50·6	29·4	21·6	7	..	..	..	55·0	44·7
0·5	79·3	67·9	52·7	31·9	23·6	8	..	..	..	55·5	45·3
0·6	79·7	68·7	54·2	34·0	25·3	9	..	..	..	56·0	45·7
0·7	80·0	69·2	55·4	35·8	26·7	∞	81·6	72·5	64·5	59·8	50·0

In the last-mentioned formulæ Bazin has adopted a mean value of the coefficients α and β for each category. These formulæ are wanting in mutual dependence, and have the

disadvantage of having two variable coefficients, while that proposed by us has only one. It will also be observed, from an inspection of the formulæ and from the preceding table of Bazin's coefficients, that when $r = o$, $c = o$, and that when r is of infinite value, the values of c become 81·65, 72·55, 64·55, and 59·76, in their respective categories, results which would lead one to the almost inadmissible conclusion, that in rivers of unlimited dimensions the influences of various conditions of roughness of the surfaces of their channels would still be appreciable to an important degree in the discharge. Although the calculation of results based on infinite dimensions may be considered impossible, we cannot neglect the indications afforded by them, which in this case lead us to believe that, if in the case of a very large river, like the Mississippi, the channel were lined for certain distances with various materials, such as smooth cement, plank, rubble, ashlar, or coated with vegetation, then the resistance or friction resulting from these various degrees of roughness of surface would be so appreciable that its influence would be felt throughout the whole of such an enormous section of water, and the quantity of water discharged would be affected in the same way as is known to be the case in small canals—a very doubtful conclusion.

We know that the amount of resistance must be far less on the whole in very large rivers than in small channels, if we take it in proportion to the whole cross section of the water in each case. For example, if we take two cross sections, one of 10 and the other of 20,000 square mètres, the resulting resistances taken in proportion to the sections are as 0·000 01 to 0·000 000 02. We therefore conclude that in a river of unlimited dimensions of section, the resistance would be infinitely small. We can also hence assume without error, that in the case of infinite dimensions the differences of influence of various degrees of roughness of

the wetted perimeter are not constant quantities, and in this respect we would prefer the formula of Gauckler as more correct; it is, however, in itself unimportant which value in that case should be given to c, in the formula $v = c\sqrt{r\,s}$, for under either assumption v will be infinite.

To return to the formula $c = \sqrt{a - \frac{a\,b}{r + b}}$, already deduced from that of D'Arcy and Bazin; this may be much simplified by modifying it so as to include only one variable coefficient throughout all the categories; and if, in accordance with the results of previous examination, we put $a = 100$ in all categories, and obtain corresponding new values for b, the relation between the two coefficients, as well as the corresponding results, may be made to remain unaltered, whatever may be the values of r.

A further simplification of the above formula may be effected by reducing it to the form

$$c = a - \frac{ab}{\sqrt{r} + b}.$$

This simple formula has been found on trial to give at least as good results as those of D'Arcy and Bazin in obtaining values of the variable coefficient c.

As it appears that the four categories of D'Arcy and Bazin are both too few in number, and are placed at intervals apart that are far too large, we have effected a further improvement by departing from their system of categories, and adopting a system of classification of twelve classes suitable for practical employment in obtaining coefficients applicable to any observed dimensions and conditions.

We give here following a table of the values of these coefficients, calculated on our principles, and arranged according to our twelve new classes, for metrical measures; as well as a table of observed results, giving the differences in

each case between the coefficient as practically and as theoretically obtained.

It will be noticed that these coefficients have not been modified so as to make any allowance for the influence of the inclination of the water surface, which we have previously shown to be important, in cases of high inclination combined with small values of r. This matter will be taken into consideration subsequently. At present we have confined ourselves to the more usual cases of ordinary inclination, and have contented ourselves with deducing one practical formula, that takes into consideration all other influences, that is supported both by the observed results of Bazin and those on the Mississippi, and is hence suited to general application.

21. Values of the Calculated Coefficients c for the Formula $v = c\sqrt{r s}$, arranged in Twelve Classes. (For Metrical Measures.)

r	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.
0	0	0	0	0	0	0	0	0	0	0	0	0
0·01	45·5	40·0	33·3	27·0	22·2	18·2	15·2	12·2	9·7	7·6	5·6	3·9
0·03	59·0	53·6	46·4	39·0	33·1	27·8	23·6	19·4	15·7	12·4	9·4	6·6
0·05	65·1	59·9	52·9	45·3	39·0	33·2	28·6	23·7	19·4	15·5	11·8	8·4
0·07	68·8	63·9	57·0	49·5	43·1	37·1	32·1	26·9	22·2	17·8	13·7	9·8
0·10	72·5	67·8	61·2	53·9	47·5	41·3	36·1	30·5	25·4	20·6	15·9	11·5
0·15	76·3	72·0	65·9	58·9	52·5	46·2	40·9	35·0	29·4	24·1	18·9	13·7
0·2	78·8	74·9	69·0	62·3	56·1	49·8	44·4	38·3	32·4	26·8	21·1	15·5
0·3	82·0	78·5	73·2	67·0	61·0	54·9	49·5	43·2	37·1	31·0	24·7	18·4
0·4	84·0	80·8	76·0	70·1	64·4	58·4	53·0	46·7	40·4	34·1	27·5	20·6
0·5	85·5	82·5	77·9	72·4	66·9	61·1	55·8	49·5	43·2	36·7	29·7	22·5
0·6	86·6	83·8	79·5	74·2	68·9	63·3	58·1	51·8	45·5	38·9	31·7	24·1
0·7	87·5	84·8	80·7	75·6	70·5	65·1	59·9	53·8	47·4	40·7	33·4	25·5
0·8	88·2	85·6	81·7	76·8	71·9	66·5	61·5	55·4	49·0	42·3	34·9	26·8
0·9	88·8	86·4	82·6	77·9	73·0	67·8	62·9	56·9	50·5	43·8	36·2	28·0
1·0	89·3	87·0	83·3	78·7	74·0	69·0	64·1	58·2	51·8	45·0	37·5	29·1
2	..	..	..	..	..	..	..	..	60·3	53·7	45·9	36·7
3	..	..	..	..	..	..	..	..	65·0	58·7	50·9	41·5
4	..	..	..	..	..	..	..	..	68·3	62·1	54·5	45·0
5	..	..	..	..	..	..	..	..	70·6	64·8	57·3	47·8
6	..	..	..	..	..	..	..	..	72·5	66·8	59·5	50·1
7	..	..	..	..	..	..	..	..	74·0	68·5	61·3	52·0
8	..	..	..	..	..	..	..	..	75·2	69·9	62·9	53·7
9	..	..	..	..	..	..	..	..	76·3	71·1	64·2	55·1
∞	100	100	100	100	100	100	100	100	100	100	100	100

22. TABLE OF OBSERVED RESULTS, WITH THEIR CORRESPONDING COEFFICIENTS.

Series of D'Arcy and Bazin.	Materials and Form of Section.	Mean Dimensions. r	s	Surface Breadth.	Depth.	Class of Coefficient.
No.						
28	Carefully planed timber—rectangular	0·022	0·00489	0·10	0·042	II
29	Carefully planed timber—rectangular	0·016	0·01524	0·10	0·024	I + 2
24	Pure cement—semicircular ..	0·250	0·00142	1·00	0·45	I + 2
2	" rectangular ..	0·150	0·00506	1·81	0·18	II + 1
25	Cement with one-third sand—semicircular	0·260	0·00138	1·00	0·49	II
26	Unplaned plank—semicircular	0·280	0·00152	1·10	0·49	III − 2
21	" trapezoidal	0·250	0·00152	1·40	0·38	IV
22	" 	0·200	0·00488	1·30	0·30	III − 3
23	" triangular 45°	0·200	0 00465	..	0·57	III − 2
6	" rectangular	0·200	0·00221	1·99	0·26	IV − 2
7	" "	0·160	0·00489	1·99	0·19	III − 3
8	" "	0·140	0·00816	1·99	0·16	III − 1
9	" "	0·220	0·00147	1·99	0·28	IV − 1
10	" "	0·140	0·00587	1·99	0·17	III − 1
11	" "	0·130	0·00838	1·99	0·15	III
18	" "	0·200	0·00460	1·20	0·28	III − 2
19	" "	0·150	0·00427	0·80	0·25	IV + 2
20	" "	0·100	0·00598	0·48	0·19	IV + 1
	Rammed gravel—					
27	0·01$^{m.}$ to 0·02$^{m.}$ thick—semicircular	0·230	0·00136	1·00	0·41	IV
4	0·01$^{m.}$ to 0·02$^{m.}$ thick—rectangular	0·200	0·00497	1·83	0·26	VII
5	0·03$^{m.}$ to 0·04$^{m.}$ thick—rectangular	0·220	0·00497	1·80	0·30	VIII − 3
	Laths nailed on—					
12	0·01$^{m.}$ apart—rectangular	0·230	0·00147	1·96	0·31	VI
13	0·01$^{m.}$ " "	0·170	0·00597	1·96	0·20	VI + 2
14	0·01$^{m.}$ " "	0·150	0·00886	1·96	0·18	VI + 2
15	0·05$^{m.}$ " "	0·290	0·00147	1·96	0·40	IX + 1
16	0·05$^{m.}$ " "	0·210	0·00600	1·96	0·27	IX + 1
17	0·05$^{m.}$ " "	0·190	0·00886	1·96	0·24	IX + 1
1·2	Ashlar—rectangular	0·540	0·00084	2·59	0·93	III + 1
39	" "	0·180	0·00810	1·20	0·26	IV − 1
3	Brickwork "	0·170	0·00502	1·91	0·20	IV − 1

Series of D'Arcy and Bazin.	Materials and Form of Section.	Mean Dimensions. r	s	Surface Breadth.	Depth.	Class of Coefficient.
No.						
32	Rubble, damaged and covered with silt—rectangular ..	0·160	0·10076	1·80	0·19	VII + ½
33	Ditto ditto— „ ..	0·200	0·03686	1·80	0·27	VII + ½
1·4	Rough rubble „ ..	0·190	0·06000	1·00	0·29	VIII − 2½
1·3	„ „ ..	0·220	0·02900	1·00	0·36	VIII + 4
1·6	„ „ ..	0·250	0·01400	1·00	0·47	VIII + 1½
1·5	„ „ ..	0·270	0·01220	1·00	0·49	VIII − 1
44	Rough rubble, the bed covered with stones and silt—rectangular	0·450	0·00032	2·00	0·80	IX + 3
45	Ditto ditto—ditto	0·400	0·00032	2·00	0·70	IX
35	Ditto ditto, damaged—trapezoidal	0·370	0·01422	1·50	0·70	IX − 1½
	Gontenbachschale, at Lake Thun, dry rubble, new and in good order—semicircular	0·100	0·04400	1·70	0·18	V − 2
	G'runnbachschale, dry rubble, damaged—semicircular	0·140	0·09927	2·80	0·25	VII − 1
	Gerbebachschale, ditto ditto	0·059	0·16800	1·14	0·00	VII − 2
	Alpbachschale at Meiringen, much damaged	0·220	0·02740	2·50	0·36	IX − 2
	Canals, Streams, and Rivers, in Earth.					
	Marseilles Canal—rounded	0·875	0·000430	6·00	1·35	X − 3½
	Jard Canal „	0·600	0·000400	6·00	1·35	XI + 2
	Chesapeake-Ohio Canal—rounded	1·122	0·000698	6·90	2·40	XII + 1
	Canal in England „	0·740	0·000063	5·40	1·20	IX + 2½
	Lauter Canal near Neuberg „	0·554	0·000664	9·00	0·55	XI + 2½
	Pannerden Canal „	3·120	0·000224	170·0	3·00	XI − 1½
	Linth Canal—trapezoidal	2·400	0·000340	37·5	3·30	XI + 4
	Canal at Marmels „	0·705	0·000500	8·00	0·78	XI − 3
	Hübengraben „	0·179	0·001300	1·48	0·24	X + 2
	Hockenbach	0·266	0·000787	3·40	0·35	X + 1
	Speyerbach, 1	0·446	0·000667	5·00	0·60	X − 3

———	Mean Dimensions.				Class of Coefficient.
	r	*s*	Surface Breadth.	Depth.	
Mississippi	20·000		760·0	35·0	X
Bayou Plaquemine	5·130	0·000170	84·0	7·8	XII − 2
Bayou La Fourche	4·000	0·000040	67·0	7·2	IX
Ohio	4·048	0·000093	325·0	2·4	X + 1
Tiber	2·883	0·000130	73·0	4·5	XI + 3
Newka	5·309	0·000015	270·0	6·4	IX − 1
Newa	10·796	0·000014	370·0	16·0	IX + 5
Weser (Schwartz)	2·900	0·000200	120·0	3·0	XI
Elbe	3·325	0·000310	96·0	3·3	XII
Rheinarme in Holland (Brünings)	3·800	0·000150	400·0	4·5	XI
Seine at Paris	3·700	0·000137	..	..	XI
Seine at Poissy, Triel, and Meulan	4·100	0·000070	..	..	XI − 2
Saone at Roconay	3·600	0·000040	..	..	XI − 3
Haine	1·600	0·000100	..	..	XI
Rhine at Speyer	2·964	0·000112	439·0	2·96	XI − 2
Rhine at Germersheim—pebbles	3·308	0·000247	228·2	..	XI + 2
Rhine at Basle—pebbles	2·100	0·001218	201·27	2·78	XII + 1
Lech—pebbles	0·963	0·001150	48·0	1·13	X + ½
Saalach—pebbles	0·422	0·001100	20·7	0·65	XI + 3
Salzach—pebbles	1·260	0·001200	115·0	3·60	XII + 2
Ysaar	1·200	0·002500	50·0	1·35	XI + 1½
Plessur— pebbles	1·070	0·009650	13·0	1·40	XI + 2
Rhine at Rheinwald	0·240	0·014200	4·3	0·30	XI
Mosa at Misox	0·380	0·011875	4·0	0·40	XI
Rhine at Domleschgerthal	0·600	0·007500	5·0	0·75	XI − 6
Escher Canal	1·240	0·003000	22·0	1·50	XII + 4
Simme at Lenk	0·500	0·010500	..	..	XII + 2

CHAPTER II.

FLOW IN OPEN CHANNELS IN EARTH.

23. The Application of the various Formulæ of Eytelwein, Patzig, Hagen, Bornemann, Brunings, Bazin, Hagen (new), Humphreys and Abbot, for Determining Discharges of Canals and Rivers in Earthen Channels.

It is of the utmost importance to the hydraulic engineer, that the velocity formulæ he may employ in his calculations of discharge and velocity for projected canals should be such as will yield trustworthy results; it is also of the greatest advantage to him that such tables as he uses for shortening the labour of calculation should not only be based on accurate formulæ, but should include velocities and discharges for all cases that occur in practice, of canals in channels in earth. We have undertaken the laborious and lengthy task of calculating such tables, with the object of supplanting those now existing that are based on erroneous or defective principles, and of affording undoubtedly accurate results even for channels of extremely large dimensions.

Vincent, in his 'Der Wiesenbau dessen Theorie und Praxis,' makes use of the well-known formula $v = c \sqrt{RJ}$ with the coefficient of Eytelwein, 92·9 for Prussian feet, and 50·9 for metrical measures. This in modern times has been shown to give results undoubtedly too large, the velocities in small canals and drains in earth being actually and invari-

ably less than those calculated with that coefficient; this conclusion is also supported by our own evidence.

At page 71, of the edition of 1858, Vincent gives an example taken from Patzig's 'Praktische Rieselwirth,' in which the latter gives a discharge of 30 cubic feet per second for a case which, according to Eytelwein, would be 98 cubic feet per second; according to Bazin in Category IV., would be 66; and according to the new general formula of Ganguillet and Kutter, already mentioned in the 'Zeitschrift des Oesterreichischen Ingenieur und Architekten-vereins' for the year 1869, would be 64 cubic feet per second, for a coefficient of roughness $n = 0 \cdot 03$; this last result is an exact arithmetical mean between those of Vincent and Patzig.

In order to compare the results obtained in extreme cases by the various formulæ, we give the following small table containing three examples taken from page 266 of Vincent's work; the two inclinations adopted throughout the three cases are the highest and lowest, and the sectional areas are the minimum, mean, and maximum. As to these results, we would observe that the results of Vincent and Eytelwein are entirely, and those of Hagen mostly, worthless.

An example for the calculation of discharges is given at page 35 of an article in the second number of the 'Cultur-Ingenieur,' by Wasserbau-Inspector Hess. The smallest discharge calculated for this example, from among the results of the formulæ of Eytelwein, Prony, Hagen (old), and Lahmeyer, is that of the last named, and is 45·89 cubic feet per second. The following comparison of this result with those obtained by the newer formulæ of Bazin, Bornemann (Gauckler's system), Hagen (1868), and Ganguillet and Kutter, show that the whole of these last give results still smaller.

Authors.	$a = 2$ Square feet.		$a = 22$ Square feet.	
	$J =$ 0·000 069 44	$J =$ 0·000 416 66	$J =$ 0·000 069 44	$J =$ 0·000 416 66
	Discharges in cubic feet per second.			
Vincent (Eytelwein)	1·07	2·62	20·19	49·44
Hagen (1868)	1·26	1·70	24·15	32·58
Bazin, Category IV. ..	0·43	1·06	12·63	30·91
Ganguillet and Kutter $n = 0·030$	0·40	1·03	10·56	27·52

Authors.	$a = 80$ Square feet.	
	$J = 0·000 069 44$	$J = 0·000 416 66$
	Discharges in cubic feet per second.	
Vincent (Eytelwein)	102·45	250·89
Hagen (1868)	115·76	156·08
Bazin, Category IV.	75·84	185·76
Ganguillet and Kutter $n = 0·030$	62·64	156·16

	Cubic Feet per Second.
Lahmeyer	45·89
Bazin, Category IV.	35·61
Bornemann (Gauckler)	39·80
Ganguillet and Kutter	
a. For channels in good order $n = 0·025$ ..	35·70
b. In moderately good order $n = 0·030$ ..	31·06
c. For channels obstructed with detritus, and strewn with stones, &c. .. .. $n = 0·035$ ..	26·80

25. The Formula of Bornemann and Hagen.

Besides the tables based on the above-mentioned formulæ, there are some of a Prussian hydraulician based on a formula $v = 83 \sqrt{RJ}$; it is perhaps almost needless to remark that this gives too high discharges for small canals in channels in earth, in the same way, though not to so great a degree, as

the formula of Eytelwein. We may hence conclude that the results of the most modern experimental observations, which are those of Bazin, are not yet generally known and employed.

We have already in the 'Zeitschrift des Oesterreichischen Ingenieur und Architekten-vereins,' for 1869, commented on the inapplicability of any of the old formulæ that have single constant coefficients to all the various degrees of roughness of wetted perimeter; we have also mentioned that we have based our conclusions principally on the careful and valuable observations of D'Arcy and Bazin, recorded in the 'Recherches Hydrauliques,' Paris, 1865; we have besides proved that any formula must assume a binomial form in order to give correct variable values of C, the coefficient in the general formula $v = c\sqrt{\mathrm{R\,J}}$. This is the case in the new formula of Bornemann, $\mathrm{R\,J} = \gamma \frac{\sqrt[5]{\mathrm{J}}}{\sqrt[3]{\mathrm{R}}} \times v$ (see 'Civil-Ingenieur'), which we consider the best of the older formulæ. We have not, however, enough space here to enable us to support our opinion on this subject by bringing forward results of observation, and comparing them fully with the results of these various formulæ, and we therefore refer to our previously mentioned article for further information about this formula, as well as for fuller detail as to the derivation of the formula which we have adopted.

For a stronger recommendation of the new formula of Hagen we must refer the reader to the articles contained in the 'Königlich Akademie der Wissen-Schaften,' Berlin, 1868, and the 'Mittheilungen des Hannoverschen Gerverbevereins,' 1868; and confine ourselves at present to the following remarks on it. This formula $v = 2{\cdot}425\sqrt{\mathrm{R}}\sqrt[6]{\mathrm{J}}$ for metrical measures is deduced from the results of the observations of Von Brünings, made with his own tachometer, on the

lower Rhine, from 1790 to 1792, on the Waal, the Leck, and the Yssel, on those seventy-five years afterwards, the results of the observations of the Mississippi Commission given in Humphreys and Abbot's work, on those on the Seine at Paris, by Poirée, and on those on the Rigoles de Chazilly et de Grosbois by Bazin, or altogether on sixty-six cases. While leaving the term $\sqrt{R}$ unaltered, Mr. Hagen introduces the sixth root of the sine of the inclination, instead of its square root, into his formula, with the object of combining the results of the experience gained on the Mississippi with that on the European rivers: the introduction of this sixth root also leads Mr. Hagen to the conclusion that the coefficient of Eytelwein, 50·9 for metrical measures, gives velocities that are nearly three times too high. A conclusion that can only be correct in some cases.

In making the trials necessary for determining the exponents most appropriate for the inclination, there is no objection to leaving the term $\sqrt{R}$ in the formula unchanged as the resulting errors introduced are approximately the same, when the exponents of J are taken at either $\frac{1}{5}$ and $\frac{1}{6}$, or $\frac{1}{2}$ and $\frac{1}{6}$.

The American results (see Hagen's article) require an exponent of $\frac{1}{5}$ or $J^{\frac{1}{5}}$, those of the Netherlands require $J^{\frac{1}{6}}$, those of the Seine at Paris $J^{\frac{1}{6}}$ or $J^{\frac{1}{5}}$, and those of the Rigoles, $J^{\frac{1}{4}}$. Hence the question arises whether it would not be more advisable to give the term R any other exponent instead of $\frac{1}{2}$, which could be suitably applied to both R and J in the velocity formula. In the article referred to the maximum and minimum values of R occurring in large rivers and small canals have very properly been taken into consideration, while however it is remarkable that the extreme values of J have been neglected, although the essential distinction between the American and the European

formulæ lies in the difference of the exponent assigned to the inclination. All the rivers as well as all the small canals compared in his article have low inclinations, in no case exceeding 0·001: if rivers of high as well as those of low inclination had been included, as is absolutely essential in attempting to deduce a general formula, there is no doubt that some other exponent for J would have been adopted instead of $\frac{1}{6}$. As also in addition to this the influence of the degree of roughness of the wetted perimeter on the velocity of discharge has been entirely neglected, in spite of the evidence afforded by the observations of D'Arcy and Bazin, the new formula of Hagen thus becomes entirely useless in calculations of discharge of the small canals and drains of the agriculturist, where this influence has most effect. This formula also appears to be not suited to artificial channels of any description, but merely to rivers; while even in these the various grades of roughness of the wetted perimeter are doubtless productive of effect, and the results due to weeds and detritus in their channels cannot be justly neglected.

The formula of Humphreys and Abbot has been previously demonstrated to be useful only under special conditions, and to be perfectly useless for high inclinations; since, then, the exponent in their formula is merely raised from $\frac{1}{2}$ to $\frac{1}{4}$, the same defect will show itself to a greater degree in that of Hagen, where the exponent is $\frac{1}{6}$. For example, in a case of well-constructed channels in masonry in good order, having an inclination of 0·1, the formula of Humphreys and Abbot gives only one quarter, and that of Hagen only one-eighth, of the actually observed velocity of discharge. In cases of lower inclination the differences are not so great.

We have compared several hundred results of observations on rivers of various hydraulic inclinations having the same

degree of roughness of surface of channel, as well as similar values of R, and tried them in the expression

$$\frac{v_0}{v_1} = \left(\frac{J_0}{J_1}\right)^x;$$

but we have never found x to be $\frac{1}{6}$; on the Mississippi alone it was found to be $\frac{1}{4}$, while in most cases it was approximately from $\frac{2}{3}$ to $\frac{1}{3}$, or averaged $\frac{1}{2}$.

If we plot a series of values of c, for the formula $c = \frac{v}{\sqrt{R\,J}}$, that have been obtained from observed results, and put them as ordinates to a series of abscissæ representing the corresponding values of R, they will be seen to show a steady increase corresponding to the increase of the values of R: these increments being greatest among the smaller values of R, and less among the greater, the resulting curve falling off very much indeed among the least values of R, showing that at last when R is infinitely small, $c = 0$.

When, however, we plot in the same way the coefficients of the Eytelwein formula, they give us a horizontal straight line, having an ordinate of 50·9; and when we plot those of the formula of Hagen, in which $C = \frac{2 \cdot 425}{\sqrt[3]{J}}$; we find them to vary not with R, but with J. These widely opposed deductions show how it is that both the formula of Eytelwein and Hagen often give results that are positively impossible;—a fact that is also true of the formula of Humphreys and Abbot.

26. Safe Bottom Velocities.

Before going on to our own formula and our tables of velocities and discharges, we will take the opportunity of mentioning the maximum velocities determined by Dubuat as suitable

to channels in various descriptions of soil, which are taken from Morin's 'Aide Mémoire de Mécanique Pratique,' p. 63, 1864. The first column in the following table gives the safe bottom velocity, and the second the mean velocity of the cross section; the formula by which these are calculated is

$$v_m = v_u + 6\sqrt{R\,J}\,.\text{ for metrical measures.}$$

We are unable, for want of observations, to judge how far these figures are trustworthy. The inclinations certainly have no influence in this case, as the corresponding velocities are mutually interdependent, but the variation of the depth of water is most probably of consequence, and in shallower depths the soil of the bottom is possibly less easily and rapidly damaged than in greater depths, under similar conditions of soil and of inclination. Yet this effect is not very large, while that of the actual velocity of the water is of the highest importance. Hence it appears that these figures may be assumed to be rather disproportionately small than too large, and we therefore recommend them more confidently.

	v_u	v_m
1. Soft brown earth	0·076	0·100
2. Soft loam	0·152	0·200
3. Sand	0·305	0·400
4. Gravel	0·609	0·800
5. Pebbles	0·914	1·200
6. Broken stone, flint	1·220	1·700
7. Conglomerate, soft slate	1·520	2·000
8. Stratified rock	1·830	2·500
9. Hard rock	3·050	4·000

27. THE DERIVATION OF THE NEW FORMULA FOR COEFFICIENTS OF MEAN VELOCITY.

The derivation of this formula is entirely omitted in the articles of the 'Cultur-Ingenieur,' the reader being referred to the 'Zeitschrift des Oesterreichischen Ingenieur und Architekten-vereins,' 1869, where it is given at full length with explanatory diagrams.

The following brief mention of the mode in which the formula is derived, is therefore extracted from that work with the view of supplying in a small degree the information that Mr. Kutter was from want of space compelled to omit in his article in the 'Cultur-Ingenieur.'

The formulæ of Bazin have the general form

$$v = \sqrt{\frac{\mathrm{R\,J}}{\alpha + \frac{\beta}{\mathrm{R}}}} \quad \text{where } c = \sqrt{\frac{1}{\alpha + \frac{\beta}{\mathrm{R}}}}$$

putting

$$\frac{1}{\alpha} = a \text{ and } \frac{1}{\beta} = b$$

it becomes

$$v = \sqrt{\frac{a.\mathrm{R}.\mathrm{J}}{1 + \frac{b}{\mathrm{R}}}} \quad \text{where } c = \sqrt{\frac{a}{1 + \frac{b}{\mathrm{R}}}} \quad (1)$$

or by adopting other coefficients, a', b', or a'', b'', it may be put into either of the forms

$$c = \frac{a'}{1 + \frac{b'}{\sqrt{\mathrm{R}}}} \quad (2) \qquad \text{or } c = \frac{a''}{1 + \frac{b''}{\mathrm{R}}} \quad (3)$$

A tabulation of these coefficients, together with those based on observed results, is necessary to determine which of these three coefficients is most correct; we therefore attach the following tabulated results for the series Nos. 24, 2, 26, 6, 9, 32, 33, and 17 of D'Arcy and Bazin, which comprise values of the coefficients *c*, as calculated according to the three formulæ already mentioned, and their differences from the actual values of *c*, as obtained by observation in those series.

VALUES OF THE COEFFICIENTS *c*—(*Metrical*).

Observed. (c)	Formula 1. (c_1)	Differences.	Formula 2. (c_2)	Differences.	Formula 3. (c_3)	Differences.
			Series No. 24.			
73·0	73·0	0·0	73·0	0·0	73·0	0·0
76·8	77·6	+0·8	77·2	+0·4	77·8	+1·0
78·2	80·0	+0·8	79·7	+1·5	80·1	+1·9
81·4	81·4	0·0	81·2	−0·2	81·5	+0·1
82·2	82·5	+0·3	82·4	+0·2	82·6	+0·4
83·3	83·3	0·0	83·3	0·0	83·3	0·0
83·1	84·0	+0·9	84·1	+1·0	83·9	+0·8
84·3	84·6	+0·3	84·7	+0·4	84·4	+0·1
86·4	84·9	−1·5	85·2	−1·2	84·7	−1·7
86·9	85·2	−1·7	85·7	−1·2	85·1	−1·8
87·4	85·6	−1·8	86·1	−1·3	85·4	−2·0
87·9	85·7	−2·2	86·2	−1·7	85·5	−2·4
Totals of differences		10·3	..	9·1	..	12·2
			Series No. 2.			
63·3	63·3	0·0	63·3	0·0	63·3	0·0
68·0	67·7	−0·3	67·7	−0·9	68·0	0·0
69·0	70·0	+1·0	69·2	+0·2	70·3	+0·3
71·9	71·2	−0·7	70·5	−1·4	71·5	−0·4
71·9	72·2	+0·3	71·6	−0·3	72·4	+0·5
73·4	72·9	−0·5	72·4	−1·0	73·1	−0·3
73·6	73·5	−0·1	73·0	−0·6	73·6	0·0
74·0	73·9	−0·1	73·5	−0·5	74·0	0·0
74·5	74·3	−0·2	74·0	−0·5	74·3	−0·2
74·5	74·6	+0·1	74·4	−0·1	74·6	+0·1
74·9	74·8	−0·1	74·8	−0·1	74·9	0·0
75·1	75·1	0·0	75·1	0·0	75·1	0·0
Totals of differences		3·4	..	5·6	..	1·8

Observed. (c).	Formula 1. (c_1).	Differences.	Formula 2. (c_2).	Differences.	Formula 3. (c_3).	Differences.
			Series No. 26.			
59·4	59·4	0·0	59·4	0·0	59·4	0·0
62·9	64·2	+1·3	63·7	+0·8	64·5	+1·6
66·5	66·4	−0·1	65·7	−0·8	66·8	+0·3
67·9	68·1	+0·2	67·6	−0·3	68·5	+0·6
68·0	69·4	+1·4	68·9	+0·9	69·7	+1·7
69·5	70·3	+0·8	69·9	+0·4	70·6	+1·1
68·8	71·1	+2·3	70·7	+1·9	71·3	+2·5
70·7	71·6	+0·9	71·3	+0·6	71·8	+1·1
70·7	72·2	+1·5	71·9	+1·2	72·3	+1·6
72·0	72·6	+0·6	72·4	+0·4	72·7	+0·7
72·0	73·0	+1·0	72·9	+0·9	73·0	+1·0
73·1	73·3	+0·2	73·2	+0·1	73·3	+0·2
73·5	73·5	0·0	73·5	0·0	73·5	0·0
Totals of differences		10·3	..	8·3	..	12·4
			Series No. 6.			
49·8	49·8	0·0	49·8	0·0	49·8	0·0
52·3	54·8	+2·5	53·8	+1·5	54·7	+2·4
55·0	57·3	+2·3	56·6	+1·6	57·7	+2·7
57·0	58·9	+1·9	58·2	+1·2	59·3	+2·3
57·2	60·0	+2·8	59·5	+2·3	60·4	+3·2
60·2	60·8	+0·6	60·3	+0·1	61·1	+0·9
60·7	61·9	+1·2	61·5	+0·8	62·1	+1·4
60·7	62·2	+1·5	61·7	+1·0	62·3	+1·6
61·9	62·6	+0·7	62·3	+0·4	62·6	+0·7
62·2	63·0	+0·8	62·8	+0·6	62·8	+0·6
63·7	63·2	−0·5	63·2	−0·5	63·0	−0·7
63·6	63·6	0·0	63·6	0·0	63·6	0·0
Totals of differences		14·8	..	10·0	..	16·5
			Series No. 9.			
49·3	47·2	−2·1	47·9	−1·4	46·2	−3·1
53·7	53·7	0·0	53·7	0·0	53·7	0·0
58·2	59·9	+1·7	59·5	+1·3	60·2	+2·0
61·6	63·0	+1·4	62·7	+1·1	63·3	+1·7
64·2	65·0	+0·8	64·9	+0·7	65·2	+1·0
66·5	66·5	0·0	66·5	0·0	66·5	0·0
67·2	67·8	+0·6	67·9	+0·7	67·6	+0·4
Totals of differences		6·6	..	5·2	..	8·2

Observed. (c).	Formula 1. (c_1).	Differences.	Formula 2. (c_2).	Differences.	Formula 3. (c_3).	Differences.
			Series No. 32.			
37·5	37·5	0·0	37·5	0·0	37·5	0·0
41·2	41·5	+0·3	41·4	+0·2	41·7	+0·5
42·7	43·8	+1·1	43·7	+1·0	43·9	+1·2
45 1	45·1	00	45·1	0·0	45·1	0·0
Totals of differences		1·4	..	1·2	..	1·7
			Series No. 33.			
39·9	39·9	0·0	39·9	0·0	39·9	0·0
44·9	43·9	+2·0	43·8	+1·9	44·1	+2·2
45·1	45·8	+0·7	45·6	+0·5	45·9	+0·8
47·0	47·0	0·0	47·0	0·0	47·0	0·0
Totals of differences		2·7		2·4		3·0
			Series No. 17.			
26·9	26·9	0·0	26·9	0·0	26·9	0·0
28·3	29·8	+1·5	29·4	+1·1	29·9	+1·6
30·8	32·0	+1·2	31·6	+0·8	32·1	+1·3
32·3	33·1	+0·8	32·8	+0·5	33·2	+0·9
33·4	33·8	+0·4	33·6	+0·2	33·9	+0·5
34·0	34·3	+0·3	34·2	+0·2	34·3	+0·3
34·7	34·7	0·0	34·7	0·9	34·7	0·0
Totals of differences		4·2		2·8		4·6

COLLECTION OF TOTALS OF DIFFERENCES.

Series 24	..	10·3	..	9·1	..	12·2
" 2	..	3·4	..	5·6	..	1·8
" 26	..	10·3	..	8·3	..	12·4
" 6	..	14·8	..	10·0	..	16·5
" 9	..	6·6	..	5·2	..	8·2
" 32	..	1·4	..	1·2	..	1·7
" 33	..	2·7	..	2·4	..	3·0
" 17	..	4·2	..	2·8	..	4·6
Totals	..	53·7	..	44·6	..	60·4

The above is conclusive in demonstrating that formula No. 2 is the best of the three, and that it yields results at least as good as the established formula of Bazin; assuming therefore this form

$$c = \frac{a'}{1 + \frac{b'}{\sqrt{R}}}$$

and inverting it, it becomes

$$\frac{1}{c} = \frac{1 + \frac{b'}{\sqrt{R}}}{a'} = \frac{1}{a'} + \frac{b'}{a'} \times \frac{1}{\sqrt{R}};$$

and this is the equation to a straight line, whose abscissa $= \frac{1}{\sqrt{R}}$, and whose ordinates are $\frac{1}{c}$; the distance of its intersection with the axis of the ordinates from the origin of the co-ordinates is $\frac{1}{a'}$, and the tangent of its inclination with the axis of the abscissæ is $\frac{b'}{a'}$.

A practical examination and comparison of these plotted coefficients with the results of observation on the Seine, Saone, Weser, a branch of the Rhine in Holland, and the Linth canal, show that this equation to the straight line does not hold entirely good, and that the observed results on the contrary indicate a curvature; it also shows that a' is not a constant quantity, but is dependent on the value of b'; so that b' may either be taken as $= na'$ or $= n^2a'$, where n represents the coefficient of roughness of the natural surface of the wetted perimeter.

Putting therefore the equation into the form

$$c = \frac{z}{1 + \frac{x}{\sqrt{R}}},$$

z may $= \frac{a.}{\sqrt{n}}$ in which case $x = n z = a\sqrt{n}$,

or z may $= \frac{a}{n}$ in which case $x = n^2 z = a\ n$.

After much examination, and further comparison, the following form is finally established as preferable:

$$z = a + \frac{l}{n}, \text{and hence } x = n z - l = a n;$$

and by introducing these quantities, the equation becomes

$$c = \frac{z}{1 + \frac{x}{\sqrt{R}}} = \frac{a + \frac{l}{n}}{1 + \frac{a n}{\sqrt{R}}}.$$

We have, however, already shown that in very large rivers the coefficients c, obtained from observation, decrease with the increase of the inclination of the water-surface; and that the formula, in order to be rendered applicable to all cases whatever, must therefore be modified by introducing a term to suit the extremes of inclination, as well as the extreme limits of sectional area. When R = infinity, c will $= z$, and the coefficients z will have their values represented by a hyperbolic curve; the terms of the equation to which curve can then be practically determined.

Hence, putting

$$z = A + \frac{m}{J}$$

the coefficients of the formula become

$$z = a + \frac{l}{n} + \frac{m}{J}$$

$$x = n z - l = \left(a + \frac{m}{J}\right) n,$$

and the formula itself takes the final form,

$$c = \frac{a + \frac{l}{n} + \frac{m}{J}}{1 + \left(a + \frac{m}{J}\right)\frac{n}{\sqrt{R}}}.$$

The effect of the introduction of these quantities into the equation is shown by comparing its values with those of the observed results on the Mississippi and other large rivers, after plotting their curves. They are found to be not only in accordance with them, but also with the following series of Bazin, Nos. 6, 8, 9, 11, 12, 14, 15, 17, 32, and 33. The form of the new general formula is hence perfectly established. The values of its various terms are deduced for metrical measures from a geometrical consideration of the hyperbolic curve plotted from it, and its coincidence with that obtained from the Mississippi observations at ten points in its length. Giving to R and J successively their ultimate values, and taking again the first general form of the equation

$$c = \frac{z}{1 + \frac{x}{\sqrt{R}}}$$

in which the new value of z will be $A + \frac{m}{J}$ after the introduction of the new term; in the extreme case, when J is of infinite value, A will $= a + \frac{l}{n}$, and this is found to be $= 60$ for metrical measures, and

$$\frac{1}{\sqrt{R}} = l, \text{ which is found } = 1,$$

and

$$\frac{1}{c} = n = 0 \cdot 027 \text{ for the Mississippi;}$$

hence

$$\frac{l}{n} = \frac{1}{0 \cdot 027} = 37;$$

therefore

$$a = \mathrm{A} - \frac{l}{n} = 60 - 37 = 23.$$

Taking again the equation $z = \mathrm{A} + \frac{m}{\mathrm{J}}$; m will be the tangent of the inclination of the asymptote with the axis of abscissæ; this straight line having as abscissæ the values of $\frac{1}{\mathrm{J}}$ and as ordinates the values of z; for the extreme case of $\mathrm{J} = 0{\cdot}000\,003\,63$ and $z = 487$ as determined from the curve, we obtain from the equation $z = \mathrm{A} + \frac{m}{\mathrm{J}}$ where $\mathrm{A} = 60$

$$m = 0{\cdot}00155.$$

The values of n are in the same way obtained by plotting observed results; and are found to vary between $0{\cdot}009$ and $0{\cdot}040$; their values as thus obtained are given in the following tables, as are also those of $a + \frac{l}{n}$ for various values of n, and those of $\frac{m}{\mathrm{J}}$ for various values of J.

The values of x and z in the formula

$$c = \frac{z}{1 + \frac{x}{\sqrt{\mathrm{R}}}}$$

are besides given for six successive values of n, namely $n = 0{\cdot}010$, $0{\cdot}012$, $0{\cdot}013$, $0{\cdot}017$, $0{\cdot}025$, and $0{\cdot}030$, in the table immediately following them.

Substituting the values of the coefficients deduced in this manner in the formula

$$c = \frac{a + \frac{l}{n} + \frac{m}{\mathrm{J}}}{1 + \left(a + \frac{m}{\mathrm{J}}\right)\frac{n}{\sqrt{\mathrm{R}}}}$$

it becomes for metrical measures

$$c = \frac{23 + \frac{1}{n} + \frac{0\cdot00155}{J}}{1 + \left(23 + \frac{0\cdot00155}{J}\right)\frac{n}{\sqrt{R}}}$$

the formula for mean velocity of discharge thus becoming

$$v = \left\{ \frac{23 + \frac{1}{n} + \frac{0\cdot00155}{J}}{1 + \left(23 + \frac{0\cdot00155}{J}\right)\frac{n}{\sqrt{R}}} \right\} \sqrt{R\,J}$$

28. Table giving the Observed Values of the Coefficient n, corresponding to their Data of Observation, in Metrical Measures.

No.	The Series of Bazin.	R	J	Breadth at water surface.	Depth.	n
28	Carefully planed plank ..	0·022	0·0048922	0·10	0·042	0·0096
29	" " ..	0·016	0·0152370	0·10	0·024	0·00870
24	In cement—semicircular ..	0·250	0·0014243	1·00	0·45	0·01005
2	" rectangular ..	0·150	0·0050600	1·81	0·18	0·01040
25	" with one third sand—semicircular	0·260	0·0013802	1·00	0·49	0·01113
26	Plank—semicircular	0·280	0·0015227	1·10	0·49	0·01195
21	" trapezoidal	0·250	0·0015213	1·40	0·38	0·01255
22		0·200	0·0048751	1·30	0·30	0·01190
23	Plank—triangular 45°	0·200	0·0046550	1·30	0·57	0·11900
6	" rectangular	0·200	0·0022136	1·99	0·26	0·13000
7	" "	0·160	0·0048889	1·99	0·19	0·01190
8	" "	0·140	0·0081629	1·99	0·16	0·01150
9	" "	0·220	0·0014678	1·99	0·28	0·01290
10	" "	0·140	0·0058744	1·99	0·17	0·01170
11	" "	0·130	0·0083805	1·99	0·15	0·01140
18	" "	0·200	0·0045988	1·20	0·28	..
19	" "	0·150	0·0042731	0·80	0·25	..
20	" "	0·100	0·0059829	0·48	0·19	..
	Rammed gravel—					
27	0·01 to 0·02^m thick—semicircular	0·230	0·0013639	1·00	0·41	0·0163
4	0·01 to 0·02^m thick—rectangular	0·200	0·0049736	1·83	0·26	0·0170

No.	The Series of Bazin.	R	J	Breadth at water surface.	Depth.	n
	Battens placed—					
12	$0 \cdot 01^m$ apart—rectangular	0·230	0·0014678	1·96	0·31	0·0149
13	$0 \cdot 01^m$ „ „	0·170	0·0059664	1·96	0·20	0·0147
14	$0 \cdot 01^m$ „ „	0·150	0·0088618	1·96	0·18	0·0149
15	$0 \cdot 05^m$ „ „	0·290	0·0014678	1·96	0·40	0·0208
16	$0 \cdot 05^m$ „ „	0·210	0·0059976	1·96	0·27	0·0211
17	$0 \cdot 05^m$ „ „	0·190	0·0088618	1·96	0·24	0·0215
1·2	Ashlar—rectangular	0·540	0·0008400	2·59	0·93	0·0133
3	Brickwork „	0·170	0·0050250	1·91	0·20	0·0129
39	Ashlar—rectangular	0·180	0·0081000	1·20	0·26	0·0129
	Rubble—					
32	Rather damaged—rectangular	0·160	0·1007600	1·80	0·19	0·0167
33	„ „	0·200	0·0368560	1·80	0·27	0·0170
1·4	„ „ new	0·190	0·0600000	1·00	0·29	0·0180
1·3	„ „ „	0·220	0·0290000	1·00	0·36	0·0184
1·6	„ „ „	0·250	0·0140000	1·00	0·47	0·0182
1·5	„ „	0·270	0·0122000	1·00	0·49	0·0192
44	With deposits on the bed—rectangular	0·450	0·0003200	2·00	0·80	0·0204
46	„ „	0·400	0·0003200	2·00	0·70	0·0210
35	Damaged rubble—trapezoidal	0·370	0·0142210	1·50	0·70	0·0220

Other Observations.

	R	J	Breadth at water surface.	Depth.	n
Gontenbachschale, new rubble—semicircular	0·100	0·044000	1·70	0·18	0·0145
G'runnbachschale — semicircular —damaged	0·140	0·099270	2·60	0·25	0·0175
Gerbebachschale — semicircular—damaged	0·059	0·168000	1·14	0·09	0·0185
Alpbachschale — semicircular — much damaged	0·220	0·027400	2·50	0·36	0·0230
Marseilles Canal	0·875	0·000430	6·00	1·35	0·0244
Jard Canal	0·600	0·000400	..	1·35	0·0255
Chesapeake Ohio Canal..	1·122	0·000698	6·90	2·40	0·0330
Canal in England	0·740	0·000063	5·40	1·20	0·0184
Lanter Canal, at Newbury	0·554	0·000664	9·00	0·55	0·0262
Pannerden Canal, in Holland ..	3·120	0·000224	170·00	3·00	0·0254
Canal of Marmels	0·705	0·000500	8·00	0·78	0·0301
Linth Canal	2·400	0·000340	37·50	3·30	0·0222
Hübengraben	0·179	0·001300	1·48	0·24	0·0237
Hockenbach	0·266	0·000787	3·40	0·35	0·0243
Speyerbach	0·446	0·000667	5·00	0·60	0·0260
Mississippi	20·000	0·000667	760·00	5·00	0·0270
Bayou Plaquemine	5·130	0·0001700	84·00	7·80	0·0294
Bayou Latorische	4·000	0·0000400	67·00	37·20	0·0200
Ohio, Point Pleasant	2·048	0·0000930	325·00	2·40	0·0210
Tiber, at Rome	2·883	0·0001300	73·00	4·50	0·0228
Newka	5·309	0·0000150	270·00	6·40	0·0252

The Series of Bazin.	R	J	Breadth at water surface.	Depth.	n
Newa	10·796	0·0000140	370·00	6·00	0·0262
Weser	2·900	0·000200	120·00	3·00	0·0232
Elbe	3·325	0·000310	96·00	13·30	0·0285
Rhine, in Holland	3·800	0·000150	400·00	4·50	0·0243
Seine, at Paris	3·700	0·000137	..	..	0·0250
Seine, at Poissy, &c.	4·100	0·000070	..	..	0·0260
Saone, at Raconnay	3·600	0·000040	..	..	0·0280
Haine	1·600	0·000100	..	..	0·0260
Channels obstructed by Detritus.					
The Rhine, at Speyer	2·964	0·000112	439·00	2·96	0·0260
Rhine, at Germersheim	3·308	0·000247	228·17	..	0·0227
Rhine, at Basle	2·100	0·001218	201·27	2·78	0·0300
Lech	0·963	0·001150	48·00	1·13	0·0220
Saalach	0·422	0·001100	20·70	0·65	0·0270
Salzach	1·260	0·001200	115·00	3·60	0·0280
Isaar	1·200	0·002500	50·00	1·35	0·0305
Escher Canal	1·240	0·003000	22·00	1·50	0·0300
Plessur	1·070	0·009650	13·00	1·40	0·0270
Rhine, at Rhinewald	0·240	0·01420	4·30	0·30	0·0310
Mösa, at Misox	0·380	0·01187	4·00	0·40	0·0310
Rhine, at Domleschgerthal	0·600	0·00750	5·00	0·75	0·0350
Simme, at Lenk	0·500	0·01050	..	..	0·0345

29. TABLE GIVING THE VALUES OF THE EXPRESSIONS $a + \frac{l}{n}$ AND $\frac{m}{J}$ FOR METRICAL MEASURES, CORRESPONDING TO VARIOUS VALUES OF n AND OF J RESPECTIVELY.

n	$a + \frac{l}{n}$	n	$a + \frac{l}{n}$	n	$a + \frac{l}{n}$
0·0090	134	0·0170	82	0·0250	63
0·0095	128	0·0175	80	0·0260	61
0·0100	123	0·0180	79	0·0270	60
0·0105	118	0·0185	77	0·0280	59
0·0110	114	0·0190	76	0·0290	57
0·0115	110	0·0195	74	0·0300	56
0·0120	106	0·0200	73	0·0310	55
0·0125	103	0·0205	72	0·0320	54
0·0130	100	0·0210	71	0·0330	53
0·0135	97	0·0215	70	0·0340	52
0·0140	94	0·0220	68	0·0350	52
0·0145	92	0·0225	67	0·0360	51
0·0150	90	0·0230	66	0·0370	50
0·0155	88	0·0235	66	0·0380	49
0 0160	86	0·0240	65	0·0390	48
0·0165	84	0·0245	64	0·0400	48

J	$\frac{m}{J}$	J	$\frac{m}{J}$	J	$\frac{m}{J}$
0·000000	∞	0·000050	31	0·00010	15·5
1	1550	51	30	11	14
2	775	52	30	12	13
3	517	53	29	13	12
4	387	54	29	14	11
5	310	55	28	15	10
6	258	56	28	16	10
7	221	57	27	17	9
8	194	58	27	18	9
9	172	59	26	19	8
0·000010	155	0·000060	26	0·00020	8
11	141	61	25	21	7
12	129	62	25	22	7
13	119	63	25	23	7
14	111	64	24	24	6
15	103	65	24	25	6
16	97	66	23	26	6
17	91	67	23	27	6
18	86	68	23	28	6
19	82	69	22	29	5
0·000020	77	0·000070	22	0·00030	5
21	84	71	22	31	5
22	70	72	22	32	5
23	67	73	21	33	5
24	65	74	21	34	5
25	62	75	21	35	4
26	60	76	20	36	4
27	57	77	20	37	4
28	55	78	20	38	4
29	53	79	20	39	4
0·000030	52	0·000080	19	0·00040	4
31	50	81	19	0·00050	3
32	48	82	19	0·00060	3
33	47	83	19	0·00070	2
34	46	84	18	0·00080	2
35	44	85	18	0·00090	2
36	43	86	18	0·001	1·55
37	42	87	18	2	0·8
38	41	88	18	3	0·5
39	40	89	17	4	0·4
0·000040	39	0·000090	17	5	0·3
41	38	91	17	6	0·3
42	37	92	17	7	0·2
43	36	93	17	8	0·2
44	35	94	16	9	0·2
45	34	95	16	0·010	0·15
46	34	96	16	0·100	0·02
47	33	97	16	∞	0·00
48	32	98	16		
49	32	99	16		

30. TABLE OF THE VALUES OF THE EXPRESSIONS z AND x, FOR METRICAL MEASURES CORRESPONDING TO DIFFERENT VALUES OF n AND J IN THE FORMULA

$$c = \frac{z}{1 + \frac{x}{\sqrt{R}}}$$

$$z = a + \frac{l}{n} + \frac{m}{J} \text{ and } x = \left(a + \frac{m}{J}\right)n = nz - l$$

Inclination J	$n = 0.010$ z	x	$n = 0.012$ z	x	$n = 0.013$ z	x	$n = 0.017$ z	x
0·0000	∞	∞	∞	∞	∞	∞	∞	∞
0·0001	138·5	0·385	121·8	0·462	115·4	0·500	97·3	0·654
2	130·7	0·307	114·1	0·369	107·7	0·400	89·6	0·523
3	128·2	0·282	115·1	0·338	105·1	0·366	87·0	0·479
4	126·9	0·269	110·2	0·320	103·8	0·349	85·7	0·457
5	126·1	0·261	109·4	0·313	103·0	0 339	84·9	0·444
6	125·6	0·256	108·9	0·307	102·5	0·332	84·4	0·435
7	125·2	0·252	108·5	0·302	102·1	0·328	84·0	0·428
8	124·9	0·249	108·3	0·299	101·8	0·324	83·8	0·424
9	124·7	0·247	108·0	0·297	101·6	0·321	83·5	0·420
0·0010	124·5	0·245	107·9	0·295	101·5	0·319	83·4	0·417
20	123·8	0·238	107·1	0·285	100·7	0·309	82·6	0·404
30	123·5	0·235	106·8	0·282	100·4	0·306	82·3	0·400
40	123·4	0·234	106·7	0·281	100·3	0·304	82·2	0·398
50	123·3	0·233	106·6	0·280	100·2	0·303	82·1	0·396
60	123·3	0·233	106·6	0·279	100·2	0·302	82·1	0·395
70	123·2	0·232	106·5	0·279	100·1	0·301	82·0	0·395
80	123·2	0·232	106·5	0·278	100·1	0·301	82·0	0·394
90	123·2	0·232	106·5	0·278	100·1	0·301	82·0	0·394
0·0100	123·15	0·231	106·48	0·278	100·06	0·301	81·97	0·393
0·0200	123·08	0·230	106·41	0·277	99·99	0·300	81·90	0·392
0·0300	123·05	0·230	106·38	0·277	99·96	0·299	81·87	0·392
0·0400	123·04	0·230	106·37	0·276	99·95	0·299	81·86	0·392
0·0500	123·03	0·230	106·36	0·276	99·94	0·299	81·85	0·391
0·0600	123·03	0·230	106·36	0·276	99·94	0·299	81·85	0·391
0·0700	123·02	0·230	106·35	0·276	99·93	0·299	81·84	0·391
0·0800	123·02	0·230	106·35	0·276	99·93	0·299	81·84	0·391
0·0900	123·02	0·230	106·35	0·276	99·93	0·299	81·84	0·391
0·1000	123·01	0·230	106·34	0·276	99·92	0·299	81·83	0·391
∞	123·00	0·230	106·33	0·276	99·91	0·299	81·82	0·391

Inclination J.	$n = 0 \cdot 025$		$n = 0 \cdot 030$	
	s	x	s	x
0·000000	∞	∞	∞	∞
0·000001	1613·0	39·325	1606·3	47·190
3	579·7	13·492	573·0	16·190
5	373·0	8·325	366·3	9·990
7	284·4	6·111	277·8	7·333
0·000010	218·0	4·450	211·3	5·340
15	166·3	3·157	159·7	3·790
20	140·5	2·512	133·8	3·015
25	125·0	2·215	118·3	2·550
30	114·7	1·867	108·0	2·240
35	107·3	1·682	100·6	2·019
40	101·7	1·544	95·1	1·852
45	97·4	1·436	90·8	1·723
50	94·0	1·350	87·3	1·620
55	91·2	1·280	84·5	1·535
60	88·8	1·221	82·2	1·465
65	86·8	1·171	80·2	1·405
70	85·1	1·128	78·5	1·354
75	83·7	1·092	77·0	1·310
80	82·4	1·059	75·7	1·271
85	81·2	1·031	74·6	1·237
90	80·2	1·005	73·6	1·206
95	79·3	0·983	72·6	1·180
0·000100	78·5	0·962	71·8	1·155
150	73·3	0·833	66·7	1·000
200	70·7	0·769	64·1	0·922
300	68·2	0·704	61·5	0·845
400	66·9	0·672	60·2	0·806
500	66·1	0·652	59·4	0·783
600	65·6	0·640	58·9	0·767
700	65·2	0·630	58·5	0·756
800	64·9	0·623	58·3	0·748
900	64·7	0·618	58·0	0·741
0·001	64·55	0·614	57·88	0·736
0·002	63·77	0·594	57·10	0·713
0·003	63·52	0·588	56·85	0·705
0·004	63·39	0·585	56·72	0·702
0·005	63·31	0·583	56·64	0·699
0·006	63·26	0·581	56·59	0·698
0·007	63·22	0·580	56·55	0·697
0·008	63·19	0·580	56·52	0·696
0·009	63·17	0·579	56·50	0·695
0·01	63·15	0·579	56·48	0·694
0·02	63·08	0·577	56·41	0·692
0·03	63·05	0·576	56·38	0·691
0·04	63·04	0·576	56·37	0·691
0·05	63·03	0·576	56·36	0·691
∞	63·00	0·575	56·33	0·690

31. The Transformation of the Final Formula from Metrical into Swiss, English, and other Measures.

The general formula for coefficients of mean velocity as deduced in the preceding paragraph, is

$$c = \frac{z}{1 + \frac{x}{\sqrt{R}}} \text{ where } c = \frac{v}{\sqrt{RJ}}$$

the terms of which are

$$z = a + \frac{l}{n} + \frac{m}{J}$$

$$x = \left(a + \frac{m}{J}\right) n.$$

In these formulæ

- v is the mean velocity of discharge;
- c is the coefficient of mean velocity;
- R is the hydraulic mean radius;
- J is the sine of the inclination of the water surface or fall in a length of 1;
- n is the natural coefficient, or coefficient dependent on the nature of the surface of the soil, or material over which the water flows;
- a, l, and m are constant coefficients, determined from experimental observation in the mode already shown.

The expression giving the value of c in a single equation is

$$c = \frac{a + \frac{l}{n} + \frac{m}{J}}{1 + \left(a + \frac{m}{J}\right) \frac{n}{\sqrt{R}}}$$

and this is applicable to measures of any description that may be employed in the formula

$$v = c\sqrt{RJ}.$$

For metrical measures, the values of a, l, and m have been found to be respectively 23, 1, and 0·00155; and n for metrical as well as for all other measures has been found to vary between 0·008 and 0·050. The local values of n for various rivers, streams, and canals, have been already given in the table at pages 67 to 69, paragraph 28. Its general values, as suited to ordinary application, are

0·009 Well-planed timber.
0·010 Plaster in pure cement.
0·011 Plaster in cement, with one-third sand.
0·012 Unplaned timber.
0·013 Ashlar and brickwork.
0·015 Canvas lining on frames.
0·017 Rubble.
0·020 Canals in very firm gravel.
0·025 Rivers and canals in perfect order and regimen, and perfectly free from stones and weeds.
0·030 Rivers and canals in moderately good order and regimen, having stones and weeds occasionally.
0·035 Rivers and canals in bad order and regimen, overgrown with vegetation, and strewn with stones, or detritus of any sort.

The variable terms of the equation are v, c, R, and J; J, the inclination or fall in a length of unity, being a sine or a ratio, remains the same for all measures; in metrical measures R will be in mètres, v in mètres per second, and c is the corresponding coefficient of mean velocity.

The formula for metrical measures thus becomes

$$(1) \qquad v = \left\{ \frac{23 + \frac{1}{n} + \frac{0 \cdot 00155}{\text{J}}}{1 + \left(23 + \frac{0 \cdot 00155}{\text{J}}\right) \frac{n}{\sqrt{\text{R}}}} \right\} \sqrt{\text{R J}} \cdot$$

To transform this equation so as to be suitable to values of R and v in other measures, the constant coefficients a, l, m, require new values (n remaining the same), which will be obtained by multiplying those given for metrical measures by the square root of the ratio that the unit of the new system bears to the unit of the metrical system, or mètre.

The square roots of these ratios for the most useful and most general systems are:

	Ratio.	Square Root.
1. Metrical measures	1·000	1·000
2. English and Russian feet	3·281	1·811
3. Austrian feet	3·163	1·779
4. Prussian feet	3·186	1·785
5. Swiss and Baden feet	3·333	1·826

The equation for each of these sorts of measures then becomes as follows:

(2) For English and Russian feet,

$$v = \left\{ \frac{41 \cdot 6 + \frac{1 \cdot 811}{n} + \frac{0 \cdot 00281}{J}}{1 + \left(41 \cdot 6 + \frac{0 \cdot 00281}{J}\right) \frac{n}{\sqrt{R}}} \right\} \sqrt{R . J} \, .$$

(3) For Austrian feet,

$$v = \left\{ \frac{41 + \frac{1 \cdot 779}{n} + \frac{0 \cdot 00276}{J}}{1 + \left(41 + \frac{0 \cdot 00276}{J}\right) \frac{n}{\sqrt{R}}} \right\} \sqrt{R \, J} \, .$$

(4) For Prussian feet,

$$v = \left\{ \frac{41 + \frac{1 \cdot 785}{n} + \frac{0 \cdot 00277}{J}}{1 + \left(41 + \frac{0 \cdot 00277}{J}\right) \frac{n}{\sqrt{R}}} \right\} \sqrt{R \, J} \, .$$

(5) For Swiss feet,

$$v = \left\{ \frac{42 + \frac{1 \cdot 826}{n} + \frac{0 \cdot 00283}{J}}{1 + \left(42 + \frac{0 \cdot 00283}{J}\right) \frac{n}{\sqrt{R}}} \right\} \sqrt{R \, J} \, .$$

This mode of reduction may be similarly applied to any other unit of measurement whatever. If the values of the coefficients and terms, c, x, and z, obtained through calculations in metrical measures require adaptation to other measures, they will in the same way require multiplying by

the square root of the ratio that the new unit bears to the mètre. Thus if c the coefficient obtained for metrical measures either from a diagram or from tables or calculation is 50·00, its value for English measures will be $50 \times 1 \cdot 811 = 90 \cdot 55$, if we retain the same general formula $v = c\sqrt{\mathrm{R\,J}}$. In actual practice, however, the general formula $v = c \times 100\sqrt{\mathrm{R\,J}}$ is more convenient for English measures, as it affords a ready mode of at once reducing the number of cyphers in the term J; in this case then the corresponding coefficient would be 0·9055, or more simply 0·91.

It will have been noticed that the earlier tables in this work from the beginning up to page 42, par. 20, are in Swiss measures; and that all the later tables from that page to the end are in metrical measures. The former are principally tables of observed results, from Switzerland as well as elsewhere, and of reductions of Bazin's calculated coefficients arranged for purposes of comparison; as then these are never required by the hydraulic engineer as working tables for purposes of calculation; and as the Swiss is nearly equal to the English foot, no object would have been gained by reducing these tables into metrical measures in this translation, except an appearance of uniformity. As, however, there might be an occasional case in which a reduction of coefficients from Swiss into other measures might be required, we annex the following factors of reduction, which can be applied in the mode already described.

	Ratio.	Square Root.
1. Metrical measures	3·000	0·546
2. English and Russian feet	0·9843	0·992
3. Austrian feet	0·9489	0·974
4. Prussian feet	0·9558	0·977
5. Swiss and Baden feet	1·000	1·000

The following tables, for facilitating conversion of metrical into English measures, may also be occasionally of use.

32. CONVERSION TABLES FOR METRICAL MEASURES (Standard of 1872).

(From Jackson's Hydraulic Manual.)

Centimètres and Inches.

Units.	Inches into Centimètres.	Square Inches into Square Centimètres.	Cubic Inches into Cubic Centimètres.	Units.	Centimètres into Inches.	Square Centimètres into Square Inches.	Cubic Centimètres into Cubic Inches.
1	2·5392	6·4476	16·3721	1	0·3938	0·1551	0·0611
2	5·0785	12·8953	32·7441	2	0·7876	0·3102	0·1222
3	7·6177	19·3429	49·1162	3	1·1815	0·4653	0·1832
4	10·1569	25·7906	65·4883	4	1·5753	0·6204	0·2443
5	12·6961	32·2382	81·8603	5	1·9691	0·7754	0·3054
6	15·2354	38·6859	98·2324	6	2·3629	0·9305	0·3665
7	17·7746	45·1335	114·6045	7	2·7567	1·0856	0·4276
8	20·3138	51·5812	130·9766	8	3·1506	1·2407	0·4886
9	22·8531	58·0288	147·3486	9	3·5444	1·3958	0·5497
10	25·3923	64·4765	163·7207	10	3·9382	1·5509	0·6108

Measures of Length.

Units.	Feet into Mètres.	Chains into Decamètres.	Miles into Kilomètres.	Units.	Mètres into Feet.	Decamètres into Chains.	Kilomètres into Miles.
1	0·3047	2·0110	1·6089	1	3·2818	0·4972	0·6215
2	0·6094	4·0221	3·2177	2	6·5636	0·9945	1·2431
3	0·9141	6·0332	4·8266	3	9·8455	1·4917	1·8647
4	1·2188	8·0443	6·4354	4	13·1273	1·9890	2·4862
5	1·5235	10·0554	8·0443	5	16·4091	2·4862	3·1078
6	1·8282	12·0665	9·6532	6	19·6910	2·9835	3·7294
7	2·1329	14·0776	11·2620	7	22·9728	3·4807	4·3509
8	2·4376	16·0886	12·8708	8	26·2546	3·9780	4·9724
9	2·7423	18·0997	14·4797	9	29·5365	4·4752	5·5940
10	3·0471	20·1108	16·0886	10	32·8183	4·9725	6·2156

Measures of Weight.

Units.	Grains into Grammes.	Pounds into Kilogrammes.	Tons into Tonneaux.	Units.	Grammes into Grains.	Kilogrammes into Pounds.	Tonneaux into Tons.
1	0·0648	0·4536	1·0160	1	15·432	2·2046	0·9842
2	0·1296	0·9072	2·0321	2	30·864	4·4092	1·9684
3	0·1944	1·3608	3·0482	3	46·297	6·6138	2·9526
4	0·2592	1·8144	4·0642	4	61·729	8·8185	3·9368
5	0·3240	2·2679	5·0802	5	77·161	11·0231	4·9210
6	0·3888	2·7216	6·0963	6	92·594	13·2277	5·9053
7	0·4536	3·1751	7·1124	7	108·026	15·4323	6·8895
8	0·5184	3·6284	8·1284	8	123·458	17·6370	7·8737
9	0·5832	4·0824	9·1445	9	138·891	19·8416	8·8578
10	0·6480	4·5359	10·1605	10	154·323	22·0462	9·8421

Measures of Pressure.

Units.	Cwt. per Lineal Foot into Kilogrammes per Linear Mètre.	Pounds per Square Inch into Kilogrammes per Square Centimètre.	Tons per Square Inch into Tonneaux per Square Centimètre.	Units.	Kilogrammes per Linear Mètre into Cwt. per Lineal Foot.	Kilogrammes per Square Centimètre into Pounds per Square Inch.	Tonneaux per Square Centimètre into Tons per Square Inch.
1	15·4788	2·9246	6·5508	1	0·0646	0·3419	0·1526
2	30·9575	5·8492	13·1015	2	0·1292	0·6839	0·3053
3	46·4363	8·7739	19·6523	3	0·1938	1·0258	0·4579
4	61·9150	11·6985	26·2030	4	0·2584	1·3677	0·6106
5	77·3938	14·6231	32·7538	5	0·3230	1·7096	0·7632
6	92·8726	17·5477	39·3046	6	0·3877	2·0516	0·9159
7	108·3513	20·4724	45·8553	7	0·4523	2·3935	1·0685
8	123·8300	23·3970	52·4061	8	0·5169	2·7354	1·2212
9	139·3089	26·3217	58·9568	9	0·5815	3·0774	1·3738
10	154·7876	29·2463	65·5076	10	0·6461	3·4193	1·5265

MEASURES OF SURFACE.

Units.	Square Feet into Square Mètres.	Acres into Hectares.	Square Miles into Square Kilomètres.	Units.	Square Mètres into Square Feet.	Hectares into Acres.	Square Kilomètres into Square Miles.
1	0·0928	0·4044	2·5884	1	10·7704	2·4725	0·3863
2	0·1857	0·8089	5·1768	2	21·5409	4·9451	0·7727
3	0·2785	1·2133	7·7652	3	32·3113	7·4176	1·1590
4	0·3714	1·6178	10·3536	4	43·0817	9·8902	1·5454
5	0·4642	2·0222	12·9420	5	53·8521	12·3627	1·9317
6	0·5571	2·4266	15·5304	6	64·6226	14·8352	2·3180
7	0·6499	2·8311	18·1188	7	75·3928	17·3078	2·7043
8	0·7428	3·2356	20·7072	8	86·1634	19·7804	3·0908
9	0·8356	3·6399	23·2956	9	96·9339	22·2528	3·4770
10	0·9285	4·0444	25·8840	10	107·7043	24·7255	3·8634

MEASURES OF CAPACITY.

Units.	Cubic Feet into Cubic Mètres.	Gallons into Litres.	Bushels into Hectolitres.	Units.	Cubic Mètres into Cubic Feet.	Litres into Gallons.	Hectolitres into Bushels.
1	0·0283	4·5417	0·3633	1	35·347	0·2202	2·7522
2	0·0566	9·0835	0·7267	2	70·693	0·4404	5·5045
3	0·0849	13·6252	1·0900	3	106·040	0·6605	8·2567
4	0·1132	18·1669	1·4534	4	141·387	0·8807	11·0090
5	0·1414	22·7086	1·8167	5	176·733	1·1009	13·7612
6	0·1698	27·2504	2·1800	6	212·080	1·3210	16·5135
7	0·1980	31·7919	2·5433	7	247·427	1·5414	19·2657
8	0·2264	36·3338	2·9067	8	282·774	1·7614	22·0180
9	0·2547	40·8756	3·2700	9	318·120	1·9816	24·7702
10	0·2829	45·4173	3·6334	10	353·467	2·2018	27·5225

Continued.

1 ton per linear inch = 2·5798 tonneaux per linear centimètre.

1 pound per square foot = 420·941 kilogrammes per square centimètre.

1 cwt. per square foot = 47142 kilogrammes per square centimètre.

1 tonneau per linear centimètre = 0·3876 tons per linear inch.

1 kilogramme per square centimètre = 0·002 374 pounds per square foot.

1 kilogramme per square centimètre = 0·000 021 cwt. per square foot.

1 quintal = 100 kilogrammes = 0·1 tonneau = 0·0984 ton.
= 1·9684 cwt. = 220·4621 pounds.

Measures of Water Supply.

A Watering in Cubic Feet per Acre of		A Watering in Cubic Mètres per Hectare of	A Watering in Cubic Mètres per Hectare of		A Watering in Cubic Feet per Acre of
1000	=	11·44	100	=	8739
2000	=	22·88	200	=	17479
3000	=	34·32	300	=	26218
4000	=	45·76	400	=	34958
5000	=	57·20	500	=	43697
6000	=	68·64	600	=	52437
7000	=	80·08	700	=	61176
8000	=	91·52	800	=	69916
9000	=	102·96	900	=	78655
10000	=	114·40	1000	=	87395

A watering of 1000 cubic yards per acre = one of 308·9 cubic mètres per hectare.

A watering of 1000 cubic mètres per hectare = one of 3236·8 cubic yards per acre.

A supply of 0·01 cubic foot per second per acre = one of 0·1144 litre per second per hectare.

A supply of 1·00 litre per second per hectare = one of 0·0874 cubic foot per second per acre.

1 hectare = 10 000 square mètres.

1 litre = 0·001 cubic mètre.

MEASURES OF HEAT.

Old Fahrenheit.	Centigrade.	Reaumur.	Improved Fahrenheit.
−13	− 25	− 20	− 45
−10	− 23·3	− 18·6	− 42
−8	− 22·2	− 17·8	− 40
−4	− 20	− 16	− 36
0	− 17·8	− 14·2	− 32
2	− 16·7	− 13·3	− 30
9·5	− 12·5	− 10	− 22·5
10	− 12·2	− 9·8	− 22
12	− 11·1	− 8·9	− 20
14	− 10	− 8	− 18
20	− 6·6	− 5·3	− 12
22	− 5·5	− 4·5	− 10
30	− 1·1	− 0·9	− 2
32	0	0	0
	Freezing point.		
35	1·7	1·3	3
40	4·4	3·6	8
42	5·5	4·5	10
50	10	8	18
52	11·1	8·9	20
54·5	12·5	10	22·5
60	12·6	12·4	28
62	16·7	13·3	30
68	20	16	36
70	21·1	16·9	38
72	22·2	17·8	40
77	25	20	45
80	26·7	21·3	48
82	27·8	22·2	50
86	30	24	54
90	32·2	25·8	58
92	33·3	26·7	60

Old Fahrenheit.	Centigrade.	Reaumur.	Improved Fahrenheit.
99·5	37·5	30	67·5
100	37·8	30·2	68
102	38·9	31·1	70
104	40	32	72·
110	43·3	34·7	78
112	44·4	35·6	80·
120	48·9	39·1	88
122	50	40	90·
130	54·4	43·6	98
132	55·6	44·4	100·
140	60	48	108
142	61·1	48·9	110·
144·5	62·5	50	112·5
150	65·6	52·4	118·
152	66·7	53·3	120
158	70	56	126·
160	71·1	56·9	128
162	72·2	57·8	130·
167	75	60	135
170	76·7	61·3	138·
172	77·8	62·2	140
176	80	64	144·
180	82·2	65·8	148
182	83·3	66·7	150·
189·5	87·5	70	157·5
190	87·8	70·2	158·
192	88·9	71·1	160
194	90	72	162·
200	93·3	74·7	168
202	94·4	75·6	170·
212	100·	80	180
	Boiling point.		

33. EQUIVALENTS OF FOREIGN MEASURES.

By Comparison with the Metrical Standards of 1872.

(From Jackson's Hydraulic Manual.)

The Feet of various Nations.

		Linear.		Square.		Cubic.	
		English Linear Feet.	Mètres.	English Square Feet.	Square Decimètres.	English Cubic Feet.	Cubic Decimètres or Litres.
1	English, American, and Russian foot	1·	0·3047	1·	9·2846	1·	28·2909
2	The mètre of France, Italy, Spain, and Portugal	3·2818	1·	10·7704	100·	35·3467	1000·
3	Rhein-fuss of Prussia, Denmark, and Norway ..	1·0299	0·3138	1·0609	9·8504	1·0928	30·9158
4	Austro-Hungarian and Bohemian Imperial foot	1·0375	0·3161	1·0762	9·9921	1·1164	31·5852
5	Swedish foot	0·9744	0·2969	0·9492	8·8130	0·9248	26·1629
6	Hanoverian foot	0·9586	0·2921	0·9189	8·5319	0·8809	24·9214
7	Bavarian foot	0·9580	0·2919	0·9174	8·5182	0·8788	24·8611
8	Wurtemberg foot	0·9402	0·2865	0·8840	8·2077	0·8311	23·5142
9	Baden foot, and Swiss (Vaud)	0·9846	0·3000	0·9693	9·0000	0·9544	27·0000
10	Portuguese foot	1·0830	0·3300	1·1729	10·8900	1·2702	35·9370
11	Spanish foot (Burgos)	0·9133	0·2783	0·8343	7·7469	0·7622	21·5623
12	Arabian foot	1·0502	0·3200	1·1029	10·2400	1·1582	32·7680

EQUIVALENTS OF FOREIGN MEASURES OF LENGTH.

MILES.	In Local Measures.	Number in a degree of latitude.	English Statute Miles.	Kilo-mètres.
The geographical mile of England and America, and nautical mile of all nations	6076·98 ft.	60·	1·1509	1·8516
English statute mile since 1824 ..	5280 ft.	69·06	1·	1·6089
Old English mile, now used on Indian canals	5000 ft.	72·93	0·9470	1·5236
Irish mile	6720 ft.	54·26	1·2728	2·0477
Scotch mile	5952 ft.	61·26	1·1273	1·8137
Kilomètre of France, Italy, Spain, and Portugal	1000 m.	111·10	0·6216	1·
Prussian and Danish post mile ..	24000 ft.	14·75	4·6816	7·5322
Austrian mile	24000 ft.	14·65	4·7136	7·5836
Russian verst	3500 ft.	104·18	0·6629	1·0664
Hungarian mile		13·33	5·1806	8·3350
Norwegian mile		10·	6·9055	11·1100
Swedish mile	36000 ft.	10·4	6·6395	10·6827
Belgian, Dutch, and Polish mile ..		20·	3·4527	5·5550
Wurtemberg geographical mile ..	26000 ft.	15·	4·6036	7·4067
Baden stunden	14815 ft.	25·	2·7622	4·4440
Bavarian mile of Anspach	28800 ft.	12·87	5·3666	8·6342
Swiss league	18000 ft.	20·58	3·3564	5·4000
Italian miglio		60·	1·1509	1·8516
Greek stadium (modern)		112·16	0·6156	0·9905
Arabian and Egyptian mile	6000 ft.	57·88	1·1933	1·9200
Portuguese milha	6236 ft.	54·	1·2788	2·0574
Spanish milla (Burgos)	5000 ft.	79·86	0·8650	1·3917
Turkish berri		66·66	1·0361	1·6670
Chinese li	360 paces.	199·72	0·3458	0·5563
Japanese ri	4 li.	49·93	1·3831	2·2253

EQUIVALENTS OF FOREIGN MEASURES OF SURFACE.

ACRES.	In Local Measures.	English Acres.	French Hectares.	Acre-side in English Feet.
English and American acre	43 560 sq. ft.	1·	0·404 44	208·7
Irish acre	70 560 sq. ft.	1·6199	0·655 11	265·6
Scotch acre	55 353 sq. ft.	1·2708	0·513 92	235·3
French hectare	10 000 sq. m.	2·4725	1·	328·2
Russian dessatina	2 400 sq.sash	2·4954	1·092 50	343·0
Prussian morgen	25 920 sq. ft.	0·6313	0·255 32	165·7
Wurtemberg morgen	38 400 sq. ft.	0·7793	0·315 17	184·1
Baden morgen	40 000 sq. ft.	0·8901	0·360 00	196·9
Amsterdam morgen	101 400 sq. ft.	2·0095	0·812 71	295·7
Polish morgow	67 500 sq. ft.	1·3843	0·559 87	245·4
Hanoverian morgen	30 720 sq. ft.	0·6476	0·261 92	167·7
Austrian jochart	57 600 sq. ft.	1·4230	0·575 54	249·0
Tyrolese jauchart	36 000 sq. ft.	0·8900	0·359 94	196·5
Swiss (Vaud) juchart	50 000 sq. ft.	1·1126	0·450 00	220·1
Norman journal	77 440 sq. ft.	2·0204	0·817 15	296·7
Bavarian tagwerk	40 000 sq. ft.	0·8425	0·340 73	191·6
Swedish tunnland	56 000 sq. ft.	1·2203	0·493 53	230·6
Danish toende-hartkorn ..	224 000 sq. ft.	5·4557	2·206 49	487·3
Piedmontese giornata	14 400 sq. ft.	0·9398	0·380 09	202·1
Venetian migliajo	25 000 sq. ft.	0·7474	0·302 30	180·1
Tuscan saccata	16 500 sq. br.	1·3895	0·561 97	245·7
Roman pezza	52 900 sq. pal.	0·6529	0·264 07	168·6
Arabian feddan	57 600 sq. ft.	1·4584	0·589 82	251·9
Portuguese geira	4 840 sq. va.	1·4480	0·585 64	251·3
Spanish cuadra cuadrada ..	22 500 sq. va.	3·9600	1·603 56	415·3
Spanish fanegada	82 944 sq. ft.	1·5888	0·642 56	262·8

Equivalents of Foreign Measures of Capacity.

Wet and Dry Measures.	Gallons.	Litres.	Side of Cube in English Feet.
English Imperial gallon of 10 lbs. water, 277·274 cub. inches ..	1·	4·54	0·543
Old English wine gallon (American) 231 cub. inches ..	0·833	3·78	0·511
Old English beer gallon, 282 cub. inches	1·017	4·62	0·549
French litre, 1 cub. decimètre ..	·220	1·	0·328
Russian vedro	2·708	12·30	0·756
Prussian anker, ⅛ of a scheffel ..	7·564	34·35	1·065
Danish anker	8·242	37·43	1·096
Swedish anker	8·641	39·24	1·114
Dutch anker..	8·387	38·09	1·102
Austrian eimer	12·774	58·01	1·263
Bavarian eimer	15·066	68·42	1·340
Wurtemberg eimer	64·721	293·93	2·189
Swiss (Vaud) eimer	8·918	40·50	1·125
Turkish alma	1·154	5·24	0·569
Portuguese almude (Lisbon) ..	3·642	16·54	0·835
Spanish arroba (Castille)	3·554	16·14	0·828
	Bushels.	Litres.	Side of Cube in English Feet.
English Imperial bushel, 8 gallons	1·	36·33	1·087
Winchester bushel (American)..	0·969	35·22	1·074
French hectolitre..	2·7522	100·	1·523
Russian tschetvert	5·772	209·73	1·948
Prussian scheffel..	1·512	54·96	1·246
Danish skieppe	0·478	17·39	0·849
Bavarian scheffel..	6·119	222·35	1·986
Wurtemberg scheffel	4·878	177·23	1·842
Dutch schepel	0·275	10·	0·707
Austrian metze	1·693	61·49	1·293
Swedish spann	1·962	73·25	1·371
Portuguese fanga (Lisbon) ..	1·488	54·08	1·239
Spanish fanega (Castille)	1·572	57·15	1·262

Equivalents of Foreign Measures of Weight.

Pounds and Tons.	Equivalent in Distilled Water according to Local Measure.	English Grains.	French Grammes.
English pound avoirdupois .. nearly	$\frac{1}{62}$ of a cub. ft.	7000	453·6
English pound troy .. .. nearly	$\frac{1}{76}$ of a cub. ft.	5760	373·2
Old English and Scotch pound nearly	$\frac{1}{58}$ of a cub. ft.	7600	492·3
French kilogramme .. .. exactly	1 cub. decim.	15432	1000·
Prussian and Wurtemberg pound ..	$\frac{1}{60}$ of a cub. ft.	7217	467·7
Danish and Norwegian pound	$\frac{1}{57}$ of a cub. ft.	7707	499·4
Swiss (Vaud) pound	$\frac{1}{56}$ of a cub. ft.	7716	500·
Austrian and Bavarian pound		8642	560·
Russian pound		6317	409·4
Swedish skālpund		6535	423·5
Portuguese arratel		7083	459·
Spanish libra (Castille)		7099	460·
	In Local lbs.	English lbs.	Kilo-grammes.
English and American hundredweight	112	112	50·80
French quintal	100 kilog.	220·46	100·
Zollverein centner	100	110·23	50·
Prussian centner	110	113·43	51·45
Austrian centner	100	123·46	56·
Russian berkowitz	400	361·01	163·76
Danish centner	100	110·10	49·94
Swedish centner	120	112·05	50·82
Portuguese quintal	128	129·53	58·75
Spanish quintal (Castille)	100	101·42	46·00
English and American ton	2240	2240·	1016·05
French tonneau	1000 kilog.	2204·6	1000·
German ton (Hamburg)	2000	2135·8	968·80
Russian ton	2400	2166·0	982·53
Portuguese ton	1728	1748·5	793·15
Spanish tonelada	2000	2028·2	920·05

34. The Application of the new Formula to the Calculation of Discharges in open Channels in Earth, and the use of the Tables and Diagram.

The following tables of velocities and discharges in open channels in earth, having an object similar to those of Claudel for pipes, are intended principally for determining the dimensions of cross-section (the depth and bottom width) of any canal designed to carry a previously fixed amount of discharge with a given velocity under limited conditions of inclination. As in these we treat only of canals and channels in earth, and not of those in masonry, brickwork, or timber, we can confine ourselves to the three following grades of roughness of surface of cross-section, indicated by the three values of n, 0·025, 0·030, and 0·035 in our formula for metrical measures:

$$v = \left\{ \frac{23 + \frac{1}{n} + \frac{0 \cdot 00155}{J}}{1 + \left(23 + \frac{0 \cdot 00155}{J}\right) \frac{n}{\sqrt{R}}} \right\} \sqrt{R \cdot J}$$

First class.—Perfectly clear and well maintained channels in loamy earth, free from irregularities, and without stones, silt, or weeds, in which $n = 0 \cdot 025$.

Second class.—Channels, rather defectively maintained, having slight irregularities, as well as gravel, stones, and weeds occasionally, in which $n = 0 \cdot 030$.

Third class.—Very defectively maintained channels with great irregularities, and having grass, weeds, and large stones, in which $n = 0 \cdot 035$.

Although these grades are rather distant from each other, they will, in practice, be found to be close enough to render any intermediate degrees needless. We had at one time intended to include the results for these three classes in one table, but have since preferred the arrangement we have

adopted, of making three separate tables, one for each class, as more convenient.

These tables are directly applicable to only one form of section, that shown in Figure 1, Plate I., a trapezoid with side slopes of $1\frac{1}{2}$ to 1; for this the true velocities and discharges are given direct; for the other forms of section, shown in Figure 2, the rectangle or the trapezoid with side slopes of 1 to 0·5, 1 to 1, 1 to 2, and 1 to 3, the velocities and discharges given for the original type of section must be reduced or modified by applying the percentages given in the additional small table constructed for that purpose, which immediately follows them. The following example will illustrate this method of reduction.

Example.—A channel of the first class, for which $n = 0 \cdot 025$, having a fall of 1 per thousand, a bottom width of 5 mètres, and a depth of 0·8 mètre, will have its side slopes altered from $1\frac{1}{2}$ to 1, to 1 to 1, what will be the effect on the velocity and on the discharge?

An inspection of the additional table shows that the velocity given for the first case must be increased by 0·3 per cent. to obtain that for the second, and the discharge reduced by 9·1 per cent., the new velocity and discharge becoming

$$v = 0 \cdot 910 + \frac{0 \cdot 910 \times 0 \cdot 3}{100} = 0 \cdot 913 \text{ mètre per second.}$$

$$q = 4 \cdot 513 - \frac{4 \cdot 513 \times 9 \cdot 1}{100} = 4 \cdot 102 \text{ cubic mètres per second.}$$

It is generally found that in such cases the percentages of velocity and of discharge vary principally with the depth of channel and are not much affected by varying either the bottom width or the inclination.

For other sections not comprised in these tables, for which a percentage of reduction cannot be conveniently calculated, the coefficient corresponding to the special case

under consideration may be obtained from the tables of coefficients, one of which accompanies and precedes those of velocity and discharge in each of the three classes; this coefficient can then be applied in the formula,

$$v = c\sqrt{\mathrm{R\,J}}$$

and the velocity and the discharge can then be calculated in the ordinary way. The values of the expression $\sqrt{\mathrm{R\,J}}$ have been tabulated by Mr. Kutter, but have been omitted in the 'Cultur-Ingenieur' for want of space; these, however, may be obtained from tables of other writers on hydraulics. For most ordinary purposes, however, this mode of determination will only be required for checking the velocities and discharges obtained direct from the tables.

Before using, as intended, the tables for reading off velocities and discharges, it will, of course, be necessary to decide whether the case under consideration is more nearly suited to the first, the second, or the third class, for which separate tables are given, or, in other words, whether the coefficient indicating the nature of the surface on which the water acts in the channel is nearer to 0·025, to 0·030, or to 0·035. Most cases fall in the second class, and intermediate classes are rarely required in actual practice. After deciding this point, and on referring to the tables, two quantities will be found to correspond to each inclination or fall per thousand and each bottom width; the upper of these, in thinner type, is the mean velocity of discharge per second in mètres, the lower, in thicker type, the discharge per second in cubic mètres corresponding to that velocity as well as to the inclination and the dimensions of cross section adopted.

Should any case happen to comprise any intermediates between the values of the dimensions or quantities, the velocities or discharges, given in the tables, there will be

no need to calculate them independently, they can easily be interpolated by proportionate differences which may be added or subtracted, as the limits within which the differences of the quantities given in the tables are kept are such as to allow this to be done with sufficient accuracy.

The following examples will explain the use of the tables.

Example 1. A channel is required to discharge 5 cubic mètres per second with an inclination of 0·008, or 0·8 per thousand; its section to be trapezoidal, with side slopes of 1½ to 1; and the highest water level in the canal is to be 0·3 mètre below the surface of the ground; the soil is clay, with one-third sand and earth; what will be the depth from the ground surface to the bottom of the channel?

The surface of the section being in smooth soil, and the channel being supposed to be kept in good order by yearly cleansing, the case may be considered as one of the first class. Now as with the given inclination several sections of different forms and dimensions may discharge the required quantity of water, it becomes a question whether greater depth and less bottom width or greater bottom width and less depth is to be preferred.

The following are the tabular depths and bottom widths that will allow of the discharge of 5 cubic mètres per second

Depths 0·8 mètre.	Bottom widths 6·3 mètres.
" 1·0 "	" 4·0 "

and if we assume that a bottom width of 5·0 mètres would be the most convenient, the depth corresponding to this, obtained by proportionate differences, will be 0·91 mètre, and the depth from ground level to the bottom of the canal will be 0·30 + 0·91 = 1·21 mètres.

Example 2. Required the mean velocity of discharge of a channel having an inclination of 0·5 per thousand, and a bottom width of 10 mètres, with side slopes of 1½ to 1, first,

when the depth of water is 1·5 mètres; secondly, when it is 1·45 mètres.

The mean velocity for neither of these cases being given direct by the tables, an intermediate velocity has to be obtained by proportionate differences.

			Mètres per second.
The tabular velocity given for a depth of	1·4	mètres is	0·971
And that for	1·6	„	1·043
Hence that for a depth of	1·5	„	1·007

For a depth of 1·45 mètres, one-fourth the difference between the two tabular velocities will be added to the first of them; thus the required velocity for that case will be

$$= 0\cdot 971 + \frac{0\cdot 072}{4} = 0\cdot 989 \text{ mètre per second.}$$

Example 3. A channel has to be conducted down sloping ground, whose soil is of such a quality as not to admit of a mean velocity of more than 1 mètre per second without injury to its bed and banks. Its maximum discharge is to be 0·5 cubic mètre per second, its section trapezoidal, with a depth of water of 0·4 mètre, and side slopes of 1½ to 1; what will be the bottom width and the inclination of the channel?

In this case it would appear that the description of soil, and the probable necessity of the adoption of a curved course down the descent would place the example in the second class, but as the table for that class is still in the press we may, for convenience sake, make use of the table for the first class, which we have at hand, as, although the results will differ, the mode of procedure will be exactly the same.

Putting, therefore, the example in the first class, and using the portion of table corresponding to the given depth of water 0·4 mètre, we find that the following inclinations and

bottom widths are all applicable to the case as a discharge of 0·5 cubic mètre per second.

0·2 per thousand	inclination	with	4·50 mètres	bottom width
0·3	„	„	3·50	„
0·4	„	„	3·00	„
0·5	„	„	2·75	„
0·6	„	„	2·50	„
0·7	„	„	2·25	„
0·8	„	„	2·00	„
0·9	„	„	1·90	„
1·0	„	„	1·80	„
1·2	„	„	1·60	„
1·4	„	„	1·45	„
1·6	„	„	1·40	„
1·8	„	„	1·00	„

In none of these cases does the mean velocity resulting exceed 1 mètre per second, being 0·250 in the first case and 0·780 in the last; hence, as land may be saved by adopting the smallest bottom width of 1·00 mètre with a fall of 2·8 per thousand, this will probably be the best in practice: or, if preferred, a higher inclination and a narrower bottom width may be calculated.

Example 4. What will be the mean velocity of discharge of a river, having an inclination of water surface of 0·000040393, a sectional area of 1864·9 square mètres, with a wetted perimeter of 514·2 mètres?

To calculate this direct from the formula without the aid of the tables, the steps are as follows:

The formula for mean velocity is

$$v = c\sqrt{\mathrm{R\,J}}$$

where

$$c = \frac{z}{1 + \dfrac{x}{\sqrt{\mathrm{R}}}}$$

$$z = a + \frac{l}{n} + \frac{m}{\mathrm{J}}$$

$$x = \left(a + \frac{m}{\mathrm{J}}\right)n$$

where for metrical measures $a = 23$, $l = 1$, $m - 0{\cdot}00155$, and n lies between $0{\cdot}008$ and $0{\cdot}050$, remaining the same for all systems of measures.

As in all cases it is necessary that the adopted value of n should be determined by comparison with observed results, and the degree of roughness of the surface of the channel acted on by the water fixed so as to be suitable to the case under consideration; we will in this case assume a value of n of $0{\cdot}025$, which is that suited to rivers and canals in very good order.

Having then all the numerical values needful, we obtain

$$z = 23 + \frac{1}{n} + \frac{0{\cdot}00155}{J}$$

$$= 23 + 40 + 38{\cdot}373 = 101{\cdot}373.$$

$$x = \left(23 + \frac{0{\cdot}00155}{J}\right) 0{\cdot}025,$$

$$= \left(\frac{23 + 38{\cdot}373}{40}\right) = 1{\cdot}5343,$$

and

$$R = \frac{1864{\cdot}9}{514{\cdot}2} = 3{\cdot}621,$$

hence

$$c = \frac{z}{1 + \frac{x}{\sqrt{R}}} = \frac{101{\cdot}373}{1 + \frac{1{\cdot}5343}{\sqrt{3{\cdot}621}}}$$

$$= \frac{101{\cdot}373}{1{\cdot}80631} = 56{\cdot}122$$

but

$$\sqrt{RJ} = \sqrt{3{\cdot}621 \times 0{\cdot}000\,040\,393} = 0{\cdot}012\,094$$

hence

$$v = 56{\cdot}122 \times 0{\cdot}012\,094 = 0{\cdot}678\,73 \text{ mètre per second.}$$

The actually observed mean velocity of the Danube at Szob, of which this is an example, is $0{\cdot}686$ mètre per

second; the small difference of 0·007 mètre between the calculated and the observed velocity is due to our having assumed too high a value of n; this, to be in accordance with the observed velocity, should be 0·0247 instead of 0·0250.

In the case mentioned in the last example, as well as in all similar cases where the mean velocity has been actually observed, the value of the correct coefficient c may be calculated by the formula $c = \frac{v}{\sqrt{RJ}}$, and the exact local value of the coefficient n by means of the formula

$$n = \sqrt{\frac{\sqrt{R}}{A c} + \frac{1}{4}\left(\frac{c - A}{c A}\right)^2 R} - \frac{1}{2} \cdot \frac{c - A}{c A} \cdot \sqrt{R}$$

where

$$A = a + \frac{m}{J}.$$

In the same way, if any three of the four quantities R, J, c, n, be given, the fourth may be calculated by means of the above formula.

Calculations of this nature, as shown in the last example, present no difficulty whatever; a large number of such examples would, however, occupy a considerable amount of time, as each would have to be calculated separately. We therefore attach a diagram, Plate I., by means of which the values of coefficients c, corresponding to given values of R, J, and n, can be read off in a few seconds with the aid of a simple straight edge, or by which any one of the four quantities R, J, n, and c can be obtained from the remaining three, in any number of cases with the least possible expenditure of time and thought.

In this diagram the diverging lines n, radiating from an origin or point where $\sqrt{R}$ and $R = 1$ mètre, indicate the grade of roughness of the surface of the channel, the curved

lines indicate the degree of inclination J of the water surface; the scale on the axis of abscissæ denotes values of R in mètres, and the scale of equal parts on the axis of ordinates gives values of the coefficient c. It is evident, therefore, that if a straight edge be laid across this diagram, in such a manner as to cut three of these lines in points corresponding to the three values given in any example, it will also cut the fourth line in a point, which will indicate to scale the value of the fourth required quantity.

We recommend the employment of this diagram to all hydraulicians that make use of our formula.

In bringing our work to a conclusion, we refer our readers for fuller information as to the derivation of our formula to the 'Zeitschrift des Oesterreichischen Ingenieur und Architekten-vereins' for 1869,* and express a hope that our formula may be universally employed.

* See Extracts therefrom introduced in paragraph 27, pages 59 to 72.

TABLES

OF

COEFFICIENTS OF MEAN VELOCITY,

AND OF

MEAN VELOCITIES AND OF DISCHARGES PER SECOND,

FOR

OPEN CHANNELS IN EARTH,

APPLICABLE TO RIVERS AND CANALS OF THREE CLASSES.

Class I.—Those having their beds and banks in good order, and perfectly free from all irregularities, deposits of stone, and overgrowth.

Class II.—Those with beds and banks in moderately good order in every respect.

Class III.—Those with beds and banks in bad order, having irregularities and deposits of stone and pebbles, or much overgrown with vegetation.

The quantities given in the following Tables are in metrical* measures, and are calculated according to the following formulæ of Ganguillet and Kutter;

$$v = c\sqrt{\mathrm{R\,J}}$$

$$c = \frac{z}{1 + \frac{x}{\sqrt{\mathrm{R}}}}$$

$$z = \frac{1}{n} + 23 + \frac{0\cdot001\,55}{\mathrm{J}}$$

$$x = n\left(23 + \frac{0\cdot001\,55}{\mathrm{J}}\right)$$

Where v is the mean velocity of discharge per second in metres,

c is the coefficient of mean velocity,

R is the hydraulic mean radius,

J is the fall of the water-surface in a length of unity,

n is the coefficient of roughness, having the fixed values of 0·025 for channels of Class I., of 0·030 for those of Class II., and of 0·035 for Class III.

The results are applicable to channels having side slopes† of 1½ to 1, having bottom-widths of from 0·2 to 270 metres, to depths of water of from 0·2 to 6 metres, and to inclinations of from 0·000 02 to 0·003 00, or of 0·02 to 3·00 per thousand.

* For conversion tables, see Paragraph No. 32 of the text.

† An additional table enables the quantities to be reduced and applied to various forms of section.

FIRST CLASS.

RIVERS AND CANALS,

HAVING THEIR BEDS AND BANKS IN GOOD ORDER,

AND PERFECTLY FREE FROM ALL IRREGULARITIES,

DEPOSITS OF STONE, AND OVERGROWTH.

$n = 0 \cdot 025.$

CLASS I. (n = 0·025.)

Coefficients of Mean Velocity.

For Values of R.

Fall per thousand.	0·1	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9
0·05	—	—	—	—	32·4	34·0	35·7	37·3	38·7
0·07	—	—	—	—	33·0	34·6	36·1	37·5	38·8
0·1	19·5	25·0	28·5	31·0	33·2	35·0	36·5	37·8	39·0
0·2	20·6	26·2	29·3	31·8	33·8	35·5	36·9	38·0	39·0
0·3	21·3	26·5	29·6	32·2	34·2	35·6	36·9	38·0	39·0
0·4	21·5	26·7	29·8	32·3	34·3	35·8	37·0	38·0	39·0
0·5	21·7	26·8	30·0	32·4	34·3	35·8	37·1	38·1	39·1
0·6	21·8	26·9	30·0	32·5	34·4	35·8	37·1	38·1	39·1
0·7	21·9	27·0	30·1	32·5	34·4	35·8	37·1	38·1	39·1
0·8	22·0	27·1	30·2	32·5	34·5	35·9	37·2	38·2	39·1
0·9	22·0	27·2	30·3	32·6	34·5	35·9	37·2	38·2	39·1
1·0	22·0	27·2	30·3	32·6	34·5	35·9	37·2	38·2	39·1

For Values of R.

Fall per thousand.	2·6	2·8	3·0	3·2	3·4	3·6	3·8	4·0	4·2
0·02	—	—	—	—	—	60·7	61·7	62·5	63·3
0·03	—	—	—	—	—	57·4	58·3	59·0	59·7
0·05	51·0	51·9	52·7	53·4	54·1	54·8	55·4	56·0	56·5
0·07	50·0	50·7	51·5	52·1	52·6	53·3	53·7	54·2	54·7
0·1	49·0	49·7	50·3	50·8	51·3	51·8	52·4	52·8	53·2
0·2	47·7	48·2	48·7	49·2	49·6	50·0	50·4	50·8	51·2
0·3	47·4	48·0	48·4	48·8	49·1	49·5	49·9	50·2	50·5
0·4	47·1	47·7	48·1	48·5	48·9	49·3	49·8	50·1	50·4
0·5	46·9	47·4	47·8	48·2	48·6	49·0	49·3	49·6	49·9
0·6	46·8	47·3	47·7	48·1	48·5	48·9	49·1	49·4	49·7
0·7	46·8	47·2	47·6	48·0	48·4	48·8	49·0	49·3	49·6
0·8	46·7	47·1	47·5	47·9	48·3	48·7	49·0	49·3	49·6
0·9	46·7	47·1	47·4	47·8	48·2	48·6	48·9	49·2	49·5
1·0	46·7	47·0	47·4	47·8	48·2	48·6	48·9	49·2	49·5

The coefficients remain unaltered for steeper inclinations.

CLASS I. ($n = 0{\cdot}025.$)

Coefficients of Mean Velocity.

For Values of R.

1·0	1·2	1·4	1·6	1·8	2·0	2·2	2·4	Fall per thousand.
40·0	42·1	43·8	45·2	46·6	47·9	49·0	50·0	0·05
40·0	42·0	43·3	44·7	46·1	47·2	48·2	49·1	0·07
40·0	41·7	43·0	44·3	45·5	46·5	47·4	48·3	0·1
40·0	41·4	42·7	43·8	44·7	45·6	46·4	47·0	0·2
40·0	41·4	42·5	43·5	44·4	45·3	46·1	46·7	0·3
40·0	41·3	42·4	43·4	44·4	45·2	45·9	46·5	0·4
40·0	41·3	42·4	43·4	44·3	45·0	45·7	46·3	0·5
40·0	41·3	42·4	43·4	44·3	45·0	45·7	46·2	0·6
40·0	41·3	42·4	43·4	44·3	45·0	45·7	46·2	0·7
40·0	41·3	42·4	43·4	44·3	45·0	45·7	46·1	0·8
40·0	41·3	42·4	43·4	44·3	45·0	45·7	46·1	0·9
40·0	41·3	42·4	43·4	44·3	45·0	45·7	46·1	1·0

For Values of R.

4·4	4·6	4·8	5·0	5·2	5·4	5·6	5·8	6·0	Fall per thousand.
64·2	64·9	65·6	66·3	67·0	67·7	68·4	69·0	69·6	0·02
60·4	61·1	61·8	62·4	62·9	63·4	63·9	64·4	64·9	0·03
57·1	57·7	58·3	58·9	59·4	59·8	60·1	60·3	60·5	0·05
55·1	55·5	55·9	56·3	56·7	57·1	57·5	57·8	58·1	0·07
53·6	54·0	54·4	54·8	55·1	55·4	55·7	56·0	56·2	0·1
51·5	51·8	52·1	52·4	52·7	53·0	53·2	53·4	53·6	0·2
50·8	51·1	51·4	51·7	52·0	52·2	52·4	52·5	52·6	0·3
50·7	51·0	51·2	51·4	51·6	51·8	52·0	52·2	52·3	0·4
50·2	50·5	50·8	51·0	51·2	51·4	51·6	51·8	52·0	0·5
50·0	50·3	50·6	50·8	51·0	51·2	51·4	51·6	51·8	0·6
49·9	50·2	50·4	50·6	50·8	51·0	51·2	51·4	51·6	0·7
49·9	50·1	50·3	50·5	50·7	50·9	51·1	51·3	51·5	0·8
49·8	50·0	50·2	50·4	50·6	50·8	51·0	51·2	51·4	0·9
49·8	50·0	50·2	50·4	50·6	50·8	51·0	51·2	51·4	1·0

The coefficients remain unaltered for steeper inclinations.

CLASS I. ($n = 0 \cdot 025$.)

Mean Velocities and Quantities of Discharge per second

For a Depth of Water of 0·2.

For Bottom-Widths of

Fall per thousand.	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9	1·0	1·2	1·4	1·6	1·8	2·0	2·5
0·1	0·066 0·007	0·070 0·008	0·073 0·010	0·076 0·012	0·079 0·014	0·081 0·016	0·083 0·018	0·085 0·019	0·087 0·021	0·089 0·025	0·091 0·031	0·093 0·035	0·095 0·039	0·097 0·043	0·099 0·052
0·2	0·099 0·010	0·105 0·013	0·110 0·015	0·114 0·018	0·118 0·021	0·121 0·024	0·124 0·027	0·127 0·030	0·129 0·032	0·133 0·040	0·137 0·046	0·140 0·053	0·142 0·060	0·144 0·066	0·146 0·082
0·3	0·125 0·012	0·132 0·016	0·138 0·019	0·144 0·023	0·148 0·027	0·152 0·030	0·155 0·034	0·158 0·038	0·161 0·042	0·166 0·050	0·170 0·058	0·174 0·066	0·177 0·074	0·180 0·083	0·182 0·102
0·4	0·145 0·014	0·154 0·018	0·161 0·022	0·167 0·027	0·172 0·031	0·177 0·035	0·181 0·040	0·184 0·044	0·187 0·049	0·192 0·058	0·197 0·068	0·202 0·077	0·206 0·086	0·209 0·096	0·212 0·119
0·5	0·164 0·016	0·173 0·021	0·181 0·025	0·188 0·030	0·194 0·035	0·199 0·040	0·203 0·045	0·207 0·050	0·210 0·055	0·216 0·065	0·222 0·075	0·227 0·086	0·231 0·097	0·235 0·108	0·238 0·134
0·6	0·180 0·018	0·190 0·023	0·199 0·028	0·207 0·033	0·213 0·038	0·219 0·043	0·223 0·049	0·227 0·055	0·231 0·060	0·238 0·071	0·244 0·083	0·250 0·095	0·254 0·107	0·258 0·119	0·262 0·147
0·7	0·195 0·019	0·206 0·025	0·216 0·030	0·224 0·036	0·229 0·041	0·233 0·047	0·240 0·053	0·246 0·059	0·251 0·065	0·258 0·077	0·265 0·090	0·271 0·103	0·276 0·116	0·280 0·129	0·284 0·159
0·8	0·210 0·021	0·222 0·027	0·232 0·032	0·241 0·038	0·249 0·044	0·255 0·051	0·260 0·057	0·265 0·064	0·269 0·070	0·277 0·083	0·284 0·097	0·291 0·110	0·296 0·124	0·300 0·138	0·304 0·170

0·9	0·223 0·022	0·235 0·028	0·245 0·034	0·256 0·041	0·264 0·047	0·271 0·054	0·277 0·061	0·282 0·067	0·287 0·075	0·294 0·088	0·301 0·102	0·308 0·117	0·314 0·132	0·319 0·147	0·324 0·181
1·0	0·235 0·023	0·247 0·030	0·259 0·036	0·270 0·043	0·278 0·050	0·286 0·057	0·292 0·064	0·297 0·071	0·302 0·078	0·310 0·093	0·318 0·108	0·325 0·123	0·331 0·139	0·337 0·155	0·342 0·191
1·2	0·257 0·026	0·270 0·032	0·283 0·039	0·296 0·047	0·305 0·055	0·314 0·063	0·320 0·071	0·326 0·078	0·331 0·086	0·340 0·102	0·348 0·118	0·356 0·135	0·362 0·152	0·368 0·168	0·374 0·210
1·4	0·278 0·028	0·293 0·035	0·307 0·043	0·320 0·051	0·332 0·060	0·343 0·068	0·348 0·076	0·353 0·084	0·358 0·093	0·367 0·110	0·376 0·128	0·385 0·146	0·392 0·165	0·398 0·181	0·404 0·226
1·6	0·297 0·030	0·313 0·037	0·328 0·046	0·342 0·055	0·352 0·063	0·362 0·072	0·369 0·081	0·376 0·090	0·382 0·099	0·392 0·118	0·402 0·137	0·411 0·156	0·418 0·175	0·425 0·195	0·432 0·243
1·8	0·315 0·031	0·331 0·040	0·347 0·049	0·362 0·058	0·373 0·067	0·384 0·076	0·392 0·086	0·399 0·095	0·406 0·105	0·416 0·125	0·426 0·145	0·436 0·166	0·444 0·186	0·451 0·207	0·458 0·256
2·0	0·332 0·033	0·350 0·042	0·367 0·051	0·382 0·061	0·394 0·071	0·405 0·081	0·413 0·091	0·421 0·101	0·428 0·111	0·439 0·132	0·450 0·153	0·460 0·175	0·468 0·197	0·476 0·219	0·483 0·270
2·2	0·348 0·035	0·368 0·044	0·386 0·054	0·401 0·064	0·413 0·074	0·424 0·084	0·433 0·095	0·441 0·106	0·448 0·116	0·460 0·138	0·472 0·160	0·483 0·183	0·491 0·206	0·499 0·230	0·507 0·284
2·4	0·364 0·036	0·384 0·045	0·402 0·056	0·418 0·067	0·431 0·077	0·443 0·088	0·452 0·099	0·460 0·110	0·468 0·122	0·480 0·144	0·492 0·167	0·504 0·191	0·513 0·215	0·521 0·240	0·529 0·295
2·6	0·379 0·038	0·400 0·048	0·420 0·059	0·436 0·070	0·450 0·081	0·461 0·092	0·470 0·103	0·479 0·115	0·487 0·127	0·500 0·150	0·512 0·174	0·524 0·198	0·534 0·224	0·543 0·250	0·551 0·308
2·8	0·393 0·039	0·416 0·050	0·436 0·061	0·452 0·072	0·466 0·084	0·479 0·095	0·489 0·107	0·498 0·119	0·506 0·131	0·520 0·156	0·532 0·181	0·544 0·206	0·554 0·232	0·563 0·259	0·572 0·317
3·0	0·407 0·041	0·430 0·051	0·451 0·063	0·468 0·075	0·483 0·087	0·496 0·099	0·506 0·111	0·515 0·123	0·523 0·136	0·537 0·160	0·550 0·187	0·563 0·214	0·573 0·241	0·583 0·268	0·592 0·331

CLASS I. (n = 0·025.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 0·4.

For Bottom-Widths of

Fall per thousand.	0·4	0·6	0·8	1·0	1·2	1·4	1·6	1·8	2·0	2·5	3·0	3·5	4·0	4·5	5·0
0·1	0·120	0·128	0·134	0·139	0·143	0·147	0·151	0·154	0·157	0·162	0·166	0·169	0·171	0·173	0·175
	0·048	0·061	0·075	0·089	0·103	0·118	0·133	0·148	0·163	0·201	0·239	0·277	0·315	0·353	0·392
0·2	0·177	0·187	0·196	0·203	0·209	0·215	0·220	0·224	0·228	0·235	0·241	0·245	0·248	0·251	0·254
	0·068	0·087	0·107	0·130	0·150	0·172	0·194	0·215	0·237	0·291	0·347	0·402	0·456	0·512	0·569
0·3	0·219	0·231	0·242	0·251	0·260	0·267	0·273	0·278	0·282	0·290	0·298	0·304	0·309	0·313	0·316
	0·086	0·110	0·135	0·161	0·187	0·214	0·240	0·267	0·293	0·360	0·429	0·499	0·569	0·638	0·708
0·4	0·254	0·268	0·282	0·292	0·302	0·310	0·317	0·323	0·328	0·337	0·346	0·353	0·359	0·363	0·366
	0·102	0·129	0·158	0·187	0·217	0·248	0·279	0·310	0·341	0·418	0·498	0·579	0·661	0·740	0·820
0·5	0·281	0·300	0·317	0·328	0·339	0·348	0·357	0·363	0·369	0·380	0·390	0·397	0·405	0·408	0·410
	0·116	0·146	0·179	0·210	0·244	0·278	0·314	0·348	0·384	0·471	0·562	0·651	0·745	0·832	0·918
0·6	0·314	0·332	0·348	0·361	0·373	0·382	0·391	0·398	0·404	0·416	0·427	0·435	0·441	0·446	0·451
	0·127	0·161	0·197	0·232	0·269	0·306	0·343	0·382	0·420	0·516	0·615	0·713	0·812	0·910	1·010
0·7	0·340	0·360	0·377	0·390	0·403	0·414	0·424	0·431	0·438	0·450	0·462	0·471	0·478	0·484	0·489
	0·136	0·173	0·211	0·250	0·290	0·331	0·373	0·414	0·456	0·558	0·665	0·772	0·879	0·987	1·095
0·8	0·364	0·384	0·403	0·423	0·431	0·443	0·453	0·461	0·468	0·481	0·494	0·503	0·510	0·516	0·522
	0·145	0·184	0·225	0·267	0·310	0·354	0·399	0·443	0·487	0·596	0·711	0·825	0·938	1·053	1·169
0·9	0·386	0·407	0·427	0·442	0·457	0·469	0·481	0·489	0·496	0·510	0·524	0·534	0·543	0·550	0·556
	0·154	0·195	0·239	0·283	0·329	0·375	0·423	0·469	0·516	0·632	0·755	0·876	0·998	1·122	1·254

1·0	0·406 0·162	0·430 0·206	0·451 0·253	0·467 0·299	0·482 0·347	0·494 0·395	0·507 0·446	0·515 0·494	0·523 0·544	0·538 0·667	0·553 0·796	0·563 0·923	0·571 1·050	0·579 1·181	0·586 1·313
1·2	0·445 0·178	0·470 0·225	0·494 0·276	0·411 0·327	0·528 0·380	0·542 0·434	0·555 0·488	0·564 0·540	0·573 0·596	0·590 0·732	0·605 0·871	0·616 1·010	0·625 1·150	0·633 1·291	0·641 1·436
1·4	0·481 0·193	0·508 0·243	0·533 0·298	0·552 0·353	0·571 0·411	0·585 0·468	0·599 0·527	0·609 0·585	0·619 0·644	0·637 0·790	0·654 0·942	0·666 1·092	0·676 1·244	0·685 1·397	0·693 1·552
1·6	0·514 0·206	0·542 0·260	0·570 0·319	0·590 0·378	0·610 0·439	0·626 0·501	0·641 0·564	0·652 0·625	0·662 0·688	0·681 0·844	0·699 1·006	0·714 1·171	0·726 1·336	0·735 1·500	0·741 1·660
1·8	0·545 0·218	0·575 0·276	0·604 0·339	0·626 0·401	0·647 0·466	0·664 0·531	0·680 0·598	0·691 0·663	0·702 0·730	0·722 0·895	0·741 1·067	0·756 1·240	0·767 1·411	0·777 1·585	0·786 1·760
2·0	0·575 0·230	0·606 0·291	0·637 0·357	0·660 0·423	0·682 0·491	0·699 0·559	0·716 0·630	0·728 0·699	0·740 0·769	0·761 0·944	0·782 1·126	0·798 1·309	0·809 1·488	0·819 1·671	0·828 1·855
2·2	0·603 0·241	0·636 0·305	0·668 0·374	0·692 0·443	0·716 0·515	0·734 0·587	0·751 0·661	0·764 0·733	0·776 0·807	0·798 0·989	0·820 1·181	0·837 1·373	0·850 1·564	0·860 1·754	0·869 1·947
2·4	0·630 0·252	0·665 0·319	0·698 0·390	0·723 0·463	0·748 0·539	0·767 0·614	0·785 0·691	0·798 0·766	0·810 0·842	0·833 1·033	0·856 1·233	0·874 1·433	0·887 1·632	0·898 1·832	0·907 2·032
2·6	0·653 0·262	0·692 0·332	0·727 0·406	0·753 0·482	0·778 0·549	0·798 0·638	0·817 0·719	0·830 0·797	0·843 0·877	0·867 1·075	0·891 1·283	0·910 1·492	0·923 1·698	0·934 1·905	0·944 2·115
2·8	0·680 0·272	0·718 0·345	0·754 0·422	0·781 0·500	0·807 0·581	0·828 0·662	0·848 0·746	0·862 0·827	0·875 0·910	0·900 1·116	0·925 1·332	0·944 1·548	0·956 1·759	0·969 1·977	0·980 2·195
3·0	0·704 0·282	0·744 0·358	0·781 0·437	0·810 0·518	0·836 0·602	0·857 0·686	0·877 0·772	0·892 0·856	0·906 0·942	0·932 1·156	0·957 1·378	0·977 1·602	0·992 1·825	1·004 2·048	1·014 2·272

CLASS I. ($n = 0\cdot025$).

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 0·6.

For Bottom-Widths of

Fall per thousand.	0·6	0·8	1·0	1·2	1·4	1·6	1·8	2·0	2·5	3·0	3·5	4·0	4·5	5·0	5·5
0·1	0·166 0·149	0·173 0·176	0·180 0·205	0·186 0·234	0·191 0·264	0·196 0·294	0·200 0·324	0·205 0·354	0·212 0·432	0·218 0·510	0·223 0·589	0·227 0·667	0·231 0·748	0·234 0·828	0·237 0·910
0·2	0·241 0·217	0·252 0·257	0·262 0·299	0·270 0·340	0·277 0·382	0·283 0·424	0·289 0·468	0·295 0·513	0·307 0·626	0·315 0·737	0·322 0·850	0·328 0·964	0·334 1·082	0·339 1·200	0·344 1·321
0·3	0·299 0·269	0·312 0·318	0·325 0·370	0·335 0·422	0·344 0·475	0·352 0·528	0·360 0·583	0·368 0·640	0·380 0·775	0·391 0·915	0·402 1·061	0·409 1·202	0·415 1·345	0·421 1·490	0·427 1·640
0·4	0·347 0·312	0·362 0·369	0·376 0·429	0·388 0·489	0·399 0·551	0·408 0·612	0·416 0·674	0·424 0·738	0·441 0·900	0·452 1·058	0·463 1·222	0·471 1·385	0·478 1·549	0·485 1·717	0·492 1·889
0·5	0·391 0·352	0·407 0·415	0·422 0·481	0·435 0·548	0·448 0·618	0·457 0·685	0·466 0·755	0·475 0·826	0·494 1·008	0·507 1·186	0·519 1·370	0·528 1·552	0·536 1·737	0·544 1·926	0·552 2·120
0·6	0·427 0·384	0·446 0·455	0·464 0·529	0·478 0·602	0·491 0·678	0·502 0·753	0·512 0·829	0·522 0·908	0·543 1·108	0·557 1·303	0·570 1·505	0·580 1·705	0·590 1·908	0·599 2·120	0·608 2·335
0·7	0·464 0·418	0·483 0·493	0·501 0·571	0·517 0·651	0·532 0·734	0·543 0·815	0·553 0·896	0·563 0·979	0·587 1·198	0·602 1·409	0·616 1·626	0·626 0·840	0·636 2·061	0·645 2·284	0·654 2·511
0·8	0·497 0·447	0·517 0·527	0·537 0·612	0·553 0·697	0·569 0·785	0·580 0·872	0·591 0·959	0·602 1·049	0·625 1·280	0·642 1·504	0·658 1·739	0·668 1·966	0·678 2·206	0·688 2·439	0·697 2·682
0·9	0·529 0·476	0·550 0·561	0·571 0·651	0·588 0·741	0·605 0·835	0·617 0·926	0·629 1·019	0·641 1·114	0·665 1·357	0·683 1·597	0·700 1·847	0·711 2·089	0·722 2·343	0·732 2·590	0·742 2·846

1·0	0·558 0·502	0·580 0·592	0·602 0·686	0·620 0·781	0·638 0·880	0·651 0·977	0·663 1·074	0·675 1·174	0·701 1·430	0·720 1·685	0·738 1·948	0·749 2·202	0·760 2·462	0·771 2·730	0·781 3·000
1·2	0·611 0·550	0·636 0·649	0·660 0·752	0·680 0·857	0·699 0·965	0·713 1·070	0·726 1·176	0·739 1·286	0·768 1·567	0·789 1·846	0·809 2·135	0·821 2·413	0·833 2·699	0·845 2·992	0·857 3·291
1·4	0·660 0·594	0·687 0·701	0·713 0·813	0·734 0·925	0·755 1·042	0·770 1·155	0·785 1·272	0·800 1·392	0·830 1·693	0·852 1·993	0·873 2·305	0·887 2·607	0·900 2·916	0·913 3·232	0·926 3·556
1·6	0·706 0·635	0·735 0·750	0·762 0·869	0·785 0·989	0·807 1·112	0·823 1·235	0·839 1·359	0·855 1·488	0·887 1·809	0·911 2·132	0·934 2·466	0·948 2·787	0·962 3·117	0·975 3·452	0·988 3·794
1·8	0·748 0·673	0·778 0·794	0·808 0·921	0·832 1·048	0·856 1·181	0·873 1·310	0·890 0·442	0·907 1·578	0·941 1·920	0·966 2·260	0·990 2·613	1·006 2·957	1·021 3·308	1·036 3·668	1·051 4·036
2·0	0·789 0·710	0·821 0·837	0·852 0·971	0·878 1·106	0·903 1·246	0·921 1·382	0·938 1·519	0·955 1·662	0·992 2·024	1·018 2·382	1·044 2·756	1·060 3·116	1·076 3·486	1·091 3·862	1·106 4·246
2·2	0·827 0·744	0·860 0·877	0·893 1·018	0·920 1·159	0·947 1·307	0·966 1·449	0·984 1·594	1·002 1·743	1·040 2·122	1·068 2·499	1·095 2·891	1·112 3·269	1·128 3·654	1·144 4·050	1·160 4·455
2·4	0·864 0·778	0·900 0·918	0·933 1·064	0·962 1·212	0·989 1·365	1·009 1·514	1·028 1·665	1·047 1·822	1·086 2·215	1·115 2·609	1·144 3·020	1·161 3·413	1·178 3·817	1·195 4·231	1·212 4·654
2·6	0·900 0·810	0·936 0·955	0·971 1·107	1·001 1·261	1·029 1·420	1·050 1·575	1·070 1·733	1·090 1·896	1·131 2·307	1·153 2·714	1·190 3·141	1·208 3·552	1·226 3·972	1·244 4·404	1·262 4·844
2·8	0·933 0·840	0·970 0·991	1·005 1·149	1·037 1·307	1·068 1·474	1·090 1·635	1·110 1·798	1·130 1·966	1·173 2·393	1·204 2·817	1·235 3·261	1·254 3·687	1·272 4·121	1·290 4·567	1·308 5·024
3·0	0·966 0·869	1·006 1·026	1·043 1·189	1·074 1·353	1·102 1·521	1·127 1·690	1·149 1·861	1·171 2·038	1·214 2·476	1·247 2·918	1·279 3·377	1·298 3·816	1·317 4·267	1·336 4·730	1·355 5·202

CLASS I. ($n = 0\cdot025$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 0·8.

For Bottom-Widths of

Fall per thousand.	1·0	1·2	1·4	1·6	1·8	2·0	2·5	3·0	3·5	4·0	4·5	5·0	5·5	6·0	6·5
0·05	0·148 0·260	0·153 0·294	0·157 0·327	0·161 0·361	0·164 0·394	0·167 0·427	0·174 0·515	0·178 0·598	0·182 0·684	0·186 0·774	0·190 0·866	0·193 0·957	0·196 1·050	0·198 1·141	0·200 1·232
0·1	0·216 0·380	0·222 0·426	0·228 0·474	0·233 0·522	0·238 0·571	0·243 0·622	0·251 0·743	0·259 0·870	0·266 1·000	0·272 1·132	0·277 1·263	0·281 1·394	0·285 1·528	0·288 1·659	0·291 1·793
0·2	0·312 0·549	0·322 0·618	0·331 0·688	0·338 0·757	0·344 0·826	0·350 0·896	0·362 1·072	0·373 1·253	0·382 1·436	0·390 1·623	0·396 1·806	0·402 1·994	0·407 2·182	0·412 2·373	0·416 2·563
0·3	0·386 0·679	0·397 0·762	0·407 0·847	0·416 0·932	0·424 1·018	0·432 1·106	0·446 1·320	0·459 1·542	0·470 1·767	0·479 1·993	0·487 2·221	0·494 2·450	0·500 2·680	0·506 2·914	0·511 3·148
0·4	0·447 0·787	0·460 0·883	0·472 0·982	0·483 1·082	0·492 1·181	0·501 1·283	0·518 1·533	0·532 1·787	0·544 2·045	0·554 2·305	0·563 2·567	0·572 2·837	0·579 3·104	0·586 3·375	0·591 3·641
0·5	0·500 0·880	0·515 0·989	0·528 1·098	0·540 1·209	0·550 1·320	0·560 1·434	0·578 1·711	0·594 1·996	0·608 2·286	0·620 2·579	0·631 2·878	0·641 3·179	0·650 3·484	0·657 3·785	0·662 4·079
0·6	0·549 0·966	0·566 1·087	0·580 1·206	0·592 1·326	0·604 1·450	0·614 1·572	0·635 1·880	0·653 2·194	0·668 2·512	0·681 2·833	0·693 3·160	0·703 3·487	0·712 3·817	0·719 4·141	0·726 4·473
0·7	0·593 1·044	0·612 1·175	0·627 1·304	0·640 1·434	0·652 1·565	0·663 1·697	0·686 2·029	0·707 2·375	0·722 2·715	0·736 3·062	0·748 3·411	0·759 3·765	0·769 4·122	0·777 4·475	0·784 4·830
0·8	0·636 1·120	0·656 1·260	0·672 1·398	0·687 1·539	0·700 1·680	0·711 1·820	0·737 2·182	0·757 2·543	0·774 2·910	0·788 3·278	0·801 3·653	0·813 4·033	0·823 4·412	0·832 4·792	0·839 5·169

0·9	0·678 1·193	0·696 1·336	0·715 1·487	0·728 1·631	0·741 1·778	0·754 1·930	0·780 2·309	0·803 2·698	0·820 3·083	0·836 3·478	0·850 3·876	0·862 4·276	0·873 4·680	0·882 5·081	0·890 5·483
1·0	0·718 1·264	0·736 1·413	0·752 1·564	0·768 1·720	0·782 1·877	0·795 2·035	0·822 2·433	0·846 2·843	0·865 3·252	0·882 3·670	0·897 4·091	0·910 4·513	0·921 4·936	0·930 5·357	0·938 5·778
1·2	0·779 1·371	0·803 1·542	0·824 1·714	0·841 1·884	0·857 2·057	0·871 2·230	0·901 2·667	0·926 3·111	0·948 3·565	0·966 4·019	0·982 4·478	0·996 4·941	1·008 5·403	1·019 5·870	1·027 6·327
1·4	0·842 1·482	0·867 1·665	0·890 1·854	0·908 2·034	0·925 2·220	0·941 2·409	0·972 2·878	0·998 3·353	1·022 3·842	1·043 4·339	1·060 4·834	1·076 5·337	1·089 5·837	1·100 6·336	1·110 6·838
1·6	0·900 1·584	0·928 1·782	0·951 1·980	0·971 2·175	0·989 2·374	1·006 2·575	1·041 3·081	1·070 3·595	1·094 4·113	1·115 4·639	1·134 5·171	1·150 5·704	1·164 6·239	1·176 6·773	1·186 7·306
1·8	0·954 1·679	0·984 1·889	1·009 2·099	1·030 2·307	1·049 2·518	1·067 2·732	1·105 3·271	1·134 3·810	1·160 4·362	1·183 4·922	1·202 5·482	1·220 6·052	1·236 6·625	1·248 7·188	1·259 7·755
2·0	1·006 1·771	1·036 1·989	1·062 2·209	1·085 2·431	1·105 2·652	1·124 2·878	1·164 3·446	1·195 4·015	1·223 4·598	1·247 5·188	1·267 5·778	1·286 6·378	1·302 6·979	1·315 7·574	1·326 8·168
2·2	1·055 1·857	1·087 2·087	1·114 2·317	1·138 2·550	1·159 2·782	1·179 3·018	1·218 3·605	1·253 4·209	1·283 4·824	1·308 5·441	1·330 6·065	1·349 6·691	1·366 7·322	1·381 7·954	1·394 8·588
2·4	1·102 1·940	1·136 2·181	1·165 2·423	1·190 2·666	1·212 2·909	1·232 3·154	1·274 3·772	1·310 4·402	1·340 5·039	1·366 5·682	1·388 6·330	1·409 6·989	1·427 7·649	1·441 8·300	1·453 8·952
2·6	1·147 2·019	1·182 2·269	1·212 2·521	1·238 2·773	1·261 3·026	1·282 3·282	1·326 3·925	1·364 4·583	1·394 5·242	1·421 5·912	1·445 6·591	1·467 7·276	1·485 7·960	1·501 8·646	1·513 9·320
2·8	1·191 2·096	1·227 2·356	1·258 2·617	1·284 2·876	1·308 3·139	1·330 3·405	1·376 4·073	1·416 4·758	1·448 5·445	1·475 6·136	1·500 6·841	1·522 7·549	1·541 8·260	1·556 8·962	1·570 9·672
3·0	1·232 2·168	1·271 2·440	1·302 2·708	1·329 2·977	1·354 3·250	1·377 3·525	1·424 4·215	1·465 4·922	1·499 5·636	1·527 6·352	1·552 7·078	1·575 7·813	1·596 8·555	1·612 9·285	1·625 10·01

CLASS I. ($n = 0 \cdot 025$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 1·0.

For Bottom-Widths of

Fall per thousand.	2·0	2·5	3·0	3·5	4·0	4·5	5·0	5·5	6·0	6·5	7·0	7·5	8·0	8·5	9·0
0·05	0·192 0·672	0·200 0·800	0·206 0·927	0·212 1·060	0·217 1·193	0·221 1·326	0·225 1·462	0·228 1·596	0·231 1·732	0·234 1·872	0·237 2·014	0·239 2·151	0·241 2·289	0·243 2·430	0·244 2·562
0·1	0·280 0·980	0·290 1·160	0·298 1·341	0·306 1·530	0·313 1·721	0·319 1·914	0·324 2·106	0·328 2·296	0·332 2·490	0·335 2·680	0·338 2·873	0·341 3·069	0·344 3·268	0·347 3·470	0·349 3·664
0·2	0·400 1·400	0·414 1·656	0·426 1·917	0·438 2·190	0·446 2·453	0·454 2·624	0·461 2·996	0·468 3·276	0·473 3·547	0·477 3·816	0·481 4·008	0·485 4·365	0·488 4·636	0·491 4·910	0·494 5·187
0·3	0·491 1·718	0·509 2·036	0·524 2·358	0·536 2·680	0·547 3·008	0·556 3·336	0·564 3·666	0·571 3·997	0·578 4·335	0·584 4·672	0·589 5·006	0·594 5·346	0·598 5·681	0·602 6·020	0·605 6·352
0·4	0·571 1·998	0·590 2·360	0·607 2·731	0·621 3·105	0·634 3·487	0·644 3·864	0·654 4·251	0·664 4·648	0·670 5·075	0·675 5·400	0·681 5·788	0·686 6·174	0·691 6·564	0·695 6·950	0·699 7·339
0·5	0·638 2·233	0·659 2·636	0·679 3·055	0·696 3·480	0·710 3·905	0·722 4·332	0·732 4·758	0·742 5·194	0·749 5·617	0·756 6·048	0·763 6·485	0·769 6·921	0·774 7·353	0·779 7·790	0·784 8·232
0·6	0·699 2·446	0·724 2·896	0·744 3·348	0·762 3·810	0·778 4·279	0·791 4·746	0·802 5·213	0·812 5·684	0·820 6·151	0·828 6·624	0·836 7·106	0·843 7·587	0·848 8·056	0·853 8·530	0·858 9·009
0·7	0·755 2·642	0·780 3·120	0·803 3·613	0·824 4·120	0·840 4·620	0·854 5·124	0·867 5·635	0·878 6·146	0·887 6·652	0·895 7·160	0·903 7·675	0·910 8·190	0·916 8·702	0·922 9·220	0·927 9·733
0·8	0·809 2·831	0·838 3·352	0·862 3·879	0·883 4·415	0·901 4·955	0·916 5·496	0·930 6·045	0·941 6·587	0·950 7·125	0·959 7·672	0·967 8·219	0·975 8·775	0·982 9·329	0·988 9·880	0·994 10·44

0·9	0·859 3·026	0·889 3·556	0·914 4·112	0·936 4·680	0·955 5·252	0·971 5·826	0·986 6·409	0·998 6·986	1·008 7·560	1·017 8·136	1·026 8·721	1·035 9·315	1·042 9·899	1·048 10·48	1·054 11·07
1·0	0·905 3·167	0·937 3·748	0·964 4·338	0·987 4·935	1·007 5·538	1·023 6·138	1·038 6·747	1·052 7·364	1·062 7·965	1·072 8·576	1·082 9·197	1·091 9·819	1·098 10·43	1·105 11·05	1·111 11·66
1·2	0·991 3·468	1·027 4·108	1·057 4·756	1·081 5·405	1·102 6·061	1·121 6·726	1·137 7·390	1·152 8·064	1·164 8·730	1·175 9·400	1·185 10·07	1·195 10·75	1·203 11·43	1·210 12·10	1·217 12·78
1·4	1·071 3·748	1·109 4·436	1·140 5·130	1·168 5·840	1·191 6·550	1·211 7·266	1·228 7·982	1·244 8·708	1·257 9·427	1·269 10·31	1·280 10·88	1·291 11·62	1·299 12·34	1·307 13·07	1·315 13·81
1·6	1·145 4·007	1·186 4·744	1·219 5·485	1·248 6·240	1·273 7·001	1·295 7·770	1·313 8·538	1·330 9·310	1·343 10·07	1·356 10·85	1·368 11·63	1·380 12·42	1·389 13·20	1·398 13·98	1·406 14·76
1·8	1·214 4·249	1·258 5·032	1·293 5·818	1·324 6·620	1·350 7·425	1·373 8·238	1·392 9·048	1·411 9·877	1·425 10·69	1·439 11·51	1·451 12·33	1·463 13·17	1·473 13·99	7·482 14·82	1·491 15·65
2·0	1·280 4·480	1·326 5·304	1·364 6·138	1·396 6·980	1·424 7·832	1·448 8·688	1·469 9·548	1·487 10·41	1·502 11·26	1·516 12·13	1·529 13·00	1·542 13·88	1·552 14·74	1·562 15·62	1·572 16·51
2·2	1·342 4·697	1·390 5·560	1·430 6·435	1·464 7·320	1·493 8·211	1·518 9·108	1·540 10·01	1·560 10·92	1·575 11·81	1·590 12·72	1·604 13·63	1·618 14·56	1·628 15·47	1·638 16·38	1·648 17·30
2·4	1·402 4·907	1·452 5·808	1·494 6·723	1·529 7·645	1·560 8·580	1·586 9·516	1·609 10·46	1·629 11·40	1·645 12·34	1·661 13·29	1·676 14·25	1·690 15·21	1·701 16·16	1·712 17·12	1·723 18·09
2·6	1·459 5·106	1·512 6·048	1·555 6·997	1·591 7·955	1·623 8·926	1·650 9·900	1·674 10·88	1·696 11·87	1·713 12·85	1·729 13·83	1·744 14·82	1·759 15·83	1·770 16·81	1·781 17·81	1·792 18·82
2·8	1·514 5·299	1·569 6·276	1·614 7·263	1·652 8·260	1·684 9·262	1·713 10·28	1·738 11·30	1·760 12·32	1·777 13·33	1·794 14·35	1·811 15·39	1·827 16·44	1·838 17·37	1·849 18·49	1·859 19·52
3·0	1·567 5·484	1·624 6·496	1·671 7·519	1·710 8·550	1·744 9·622	1·773 10·64	1·798 11·69	1·821 12·75	1·839 13·79	1·857 14·86	1·873 15·92	1·889 17·00	1·901 18·06	1·913 19·13	1·925 20·21

CLASS I. ($n = 0 \cdot 025$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 1·2.

For Bottom-Widths of

Fall per thousand.	3·5	4·0	4·5	5·0	5·5	6·0	6·5	7·0	7·5	8·0	8·5	9·0	9·5	10	11
0·05	0·239 1·520	0·244 1·698	0·249 1·882	0·253 2·074	0·257 2·205	0·261 2·443	0·264 2·630	0·267 2·820	0·270 3·013	0·272 3·199	0·274 3·386	0·276 3·577	0·279 3·784	0·281 3·979	0·283 4·347
0·1	0·342 2·175	0·349 2·429	0·356 2·691	0·362 2·953	0·367 3·215	0·372 3·482	0·376 3·745	0·379 4·002	0·382 4·263	0·385 4·528	0·388 4·795	0·391 5·068	0·394 5·342	0·397 5·621	0·400 6·145
0·2	0·485 3·085	0·496 3·452	0·505 3·818	0·512 4·178	0·519 4·547	0·525 4·914	0·531 5·288	0·536 5·660	0·541 6·037	0·545 6·409	0·549 6·786	0·553 7·166	0·558 7·567	0·562 7·958	0·566 8·694
0·3	0·595 3·785	0·608 4·232	0·618 4·672	0·627 5·117	0·636 5·572	0·644 6·028	0·651 6·483	0·657 6·940	0·663 7·398	0·668 7·857	0·673 8·318	0·678 8·788	0·684 9·270	0·689 9·757	0·694 10·66
0·4	0·686 4·363	0·702 4·885	0·714 5·398	0·724 5·909	0·734 6·431	0·743 6·955	0·752 7·490	0·759 8·015	0·765 8·537	0·771 9·066	0·777 9·603	0·783 10·15	0·789 10·70	0·795 11·26	0·801 12·30
0·5	0·770 4·898	0·787 5·478	0·800 6·048	0·812 6·627	0·823 7·210	0·833 7·797	0·843 8·397	0·850 8·976	0·857 9·563	0·863 10·15	0·869 10·74	0·875 11·34	0·882 11·96	0·889 12·59	0·895 13·75
0·6	0·843 5·362	0·862 6·000	0·877 6·630	0·890 7·263	0·902 7·901	0·913 8·545	0·923 9·194	0·932 9·842	0·940 10·25	0·947 11·13	0·953 11·78	0·959 12·43	0·967 13·11	0·974 13·79	0·981 15·42
0·7	0·910 5·788	0·931 6·479	0·947 7·160	0·961 7·862	0·974 8·531	0·986 9·228	0·997 9·929	1·006 10·62	1·015 11·33	1·022 12·02	1·029 12·72	1·035 13·41	1·043 14·14	1·051 14·88	1·059 16·27
0·8	0·974 6·195	0·996 6·949	1·013 7·658	1·028 8·389	1·041 9·118	1·054 9·865	1·066 10·62	1·076 11·36	1·085 12·11	1·092 12·84	1·099 13·55	1·106 14·33	1·114 15·10	1·122 15·88	1·132 17·38

0·9	1·035 6·583	1·056 7·350	1·074 8·119	1·090 8·893	1·104 9·672	1·118 10·46	1·131 11·26	1·141 12·05	1·151 12·84	1·159 13·63	1·167 14·42	1·174 15·22	1·182 16·03	1·190 16·85	1·201 18·44
1·0	1·093 6·962	1·113 7·747	1·132 8·559	1·149 9·376	1·164 10·20	1·178 11·03	1·192 11·87	1·203 12·70	1·213 13·54	1·222 14·37	1·230 15·20	1·238 16·04	1·246 16·90	1·255 17·77	1·266 19·44
1·2	1·195 7·600	1·219 8·484	1·240 9·374	1·259 10·27	1·275 11·17	1·291 12·08	1·306 13·01	1·318 13·92	1·329 14·83	1·338 15·74	1·347 16·65	1·356 17·57	1·365 18·51	1·374 19·45	1·386 21·29
1·4	1·291 8·211	1·317 9·167	1·340 10·13	1·360 11·10	1·377 12·06	1·394 13·05	1·410 14·04	1·423 15·03	1·435 16·01	1·445 16·99	1·455 17·98	1·465 18·98	1·475 20·00	1·485 21·03	1·498 23·01
1·6	1·380 8·776	1·408 9·800	1·432 10·83	1·454 11·87	1·474 12·91	1·491 13·96	1·508 15·02	1·521 16·06	1·534 17·12	1·545 18·17	1·556 19·23	1·566 20·30	1·577 21·38	1·588 22·48	1·602 24·61
1·8	1·464 9·311	1·493 10·39	1·519 11·48	1·542 12·58	1·562 13·69	1·583 14·81	1·603 15·93	1·615 17·05	1·627 18·17	1·639 19·29	1·650 20·41	1·661 21·53	1·673 22·66	1·685 23·80	1·699 26·10
2·0	1·543 9·813	1·574 10·95	1·601 12·10	1·625 13·26	1·646 14·42	1·666 15·60	1·686 16·79	1·701 17·96	1·715 19·14	1·727 20·31	1·739 21·49	1·750 22·68	1·763 23·90	1·776 25·15	1·791 27·51
2·2	1·619 10·30	1·651 11·49	1·680 12·70	1·705 13·91	1·727 15·13	1·748 16·36	1·768 17·61	1·784 18·84	1·799 20·08	1·812 21·31	1·824 22·54	1·836 23·80	1·849 25·07	1·862 26·36	1·878 28·85
2·4	1·691 10·75	1·724 12·00	1·754 13·26	1·780 14·52	1·803 15·79	1·825 17·08	1·847 18·40	1·863 19·67	1·879 20·97	1·892 22·25	1·905 23·54	1·917 24·84	1·930 26·17	1·943 27·51	1·962 30·14
2·6	1·760 11·19	1·795 12·49	1·826 13·80	1·853 15·12	1·877 16·44	1·900 17·78	1·922 19·14	1·937 20·45	1·956 21·83	1·970 23·17	1·983 24·51	1·996 25·87	2·009 27·24	2·022 28·63	2·042 31·36
2·8	1·826 11·61	1·863 12·97	1·895 14·33	1·923 15·69	1·948 17·06	1·971 18·45	1·994 19·86	2·012 21·25	2·029 22·64	2·043 24·03	2·057 25·42	2·071 26·84	2·085 28·27	2·100 29·74	2·119 32·54
3·0	1·890 12·03	1·928 13·44	1·961 14·86	1·991 16·27	2·016 17·68	2·041 19·09	2·065 20·53	2·083 21·96	2·101 23·40	2·116 24·85	2·130 26·31	2·144 27·78	2·158 29·26	2·172 30·75	2·193 33·68

CLASS I. ($n = 0\cdot025.$)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 1·4.

For Bottom-Widths of

Fall per thousand.	5·0	5·5	6·0	6·5	7·0	7·5	8·0	8·5	9·0	9·5	10	11	12	13	14
0·05	0·281 2·793	0·285 3·035	0·289 3·277	0·292 3·519	0·295 3·762	0·298 4·005	0·301 4·250	0·303 4·498	0·306 4·748	0·308 4·999	0·310 5·252	0·314 5·746	0·317 6·242	0·319 6·738	0·321 7·236
0·1	0·397 3·946	0·403 4·284	0·408 4·623	0·412 4·963	0·416 5·303	0·420 5·644	0·424 5·987	0·427 6·332	0·430 6·680	0·433 7·032	0·436 7·386	0·441 8·089	0·445 8·795	0·449 9·504	0·453 10·21
0·2	0·561 5·577	0·570 6·049	0·577 6·523	0·582 7·000	0·587 7·477	0·592 7·956	0·596 8·438	0·600 8·923	0·605 9·411	0·610 9·902	0·614 10·40	0·620 11·37	0·625 12·35	0·630 13·33	0·635 14·31
0·3	0·689 6·849	0·698 7·426	0·706 8·006	0·712 8·588	0·719 9·172	0·726 9·757	0·732 10·34	0·737 10·93	0·742 11·53	0·747 12·13	0·752 12·74	0·762 13·96	0·772 15·19	0·778 16·43	0·784 17·67
0·4	0·795 7·903	0·806 8·568	0·815 9·236	0·823 9·917	0·831 10·59	0·838 11·26	0·845 11·93	0·852 12·61	0·858 13·30	0·863 14·00	0·868 14·70	0·876 16·08	0·884 17·46	0·891 18·85	0·898 20·24
0·5	0·889 8·837	0·901 9·581	0·911 10·33	0·920 11·08	0·929 11·83	0·937 12·59	0·945 13·35	0·952 14·11	0·959 14·88	0·965 15·66	0·971 16·45	0·980 18·00	0·989 19·54	0·997 21·08	1·004 22·63
0·6	0·974 9·685	0·986 10·50	0·997 11·32	1·007 12·14	1·017 12·97	1·027 13·80	1·035 14·63	1·043 15·46	1·050 16·30	1·057 17·15	1·063 18·00	1·073 19·70	1·083 21·40	1·092 23·10	1·100 24·79
0·7	1·052 10·46	1·066 11·34	1·078 12·23	1·088 13·12	1·099 14·01	1·109 14·90	1·118 15·80	1·127 16·71	1·134 17·62	1·141 18·53	1·148 19·44	1·159 21·27	1·170 23·11	1·180 24·95	1·189 26·80
0·8	1·125 11·18	1·139 12·12	1·151 13·07	1·163 14·02	1·174 14·97	1·185 15·92	1·196 16·88	1·207 17·85	1·214 18·82	1·221 19·80	1·227 20·78	1·239 22·78	1·251 24·69	1·261 26·65	1·270 28·62

0·9	1·193 11·86	1·208 12·86	1·221 13·87	1·234 14·87	1·246 15·88	1·257 16·89	1·268 17·90	1·278 18·92	1·286 19·95	1·294 21·00	1·302 22·05	1·315 24·12	1·327 26·20	1·338 28·29	1·348 30·38
1·0	1·257 12·49	1·274 13·55	1·288 14·61	1·301 15·68	1·314 16·75	1·326 17·82	1·337 18·90	1·347 19·98	1·356 21·07	1·365 22·16	1·373 23·26	1·386 25·44	1·399 27·63	1·410 29·82	1·421 32·02
1·2	1·377 13·69	1·395 14·85	1·410 16·01	1·425 17·18	1·439 18·35	1·452 19·52	1·464 20·70	1·475 21·89	1·485 23·08	1·495 24·27	1·504 25·47	1·518 27·86	1·532 30·26	1·544 32·62	1·556 35·07
1·4	1·488 14·79	1·507 16·03	1·524 17·28	1·539 18·54	1·554 19·80	1·568 21·07	1·581 22·34	1·593 23·62	1·604 24·91	1·614 26·20	1·624 27·51	1·640 30·10	1·655 32·70	1·668 35·30	1·681 37·89
1·6	1·590 15·80	1·611 17·14	1·629 18·49	1·645 19·84	1·661 21·19	1·677 22·54	1·691 23·90	1·704 25·27	1·715 26·64	1·726 28·02	1·736 29·40	1·753 32·16	1·769 34·93	1·783 37·71	1·797 40·50
1·8	1·687 16·77	1·709 18·19	1·728 19·61	1·745 21·03	1·762 22·46	1·778 23·90	1·793 25·35	1·807 26·80	1·819 28·26	1·830 29·72	1·841 31·19	1·854 34·15	1·877 37·11	1·894 40·08	1·910 43·05
2·0	1·778 17·67	1·801 19·17	1·822 20·67	1·840 22·18	1·857 23·68	1·874 25·19	1·890 26·71	1·905 28·24	1·917 29·78	1·929 31·33	1·941 32·88	1·960 35·97	1·978 39·07	1·994 42·17	2·009 45·28
2·2	1·865 18·54	1·889 20·11	1·910 21·68	1·930 23·26	1·948 24·84	1·966 26·42	1·982 28·01	1·998 29·61	2·011 31·22	2·024 32·85	2·036 34·49	2·055 37·73	2·074 40·98	2·091 44·23	2·107 47·49
2·4	1·948 19·36	1·973 21·00	1·994 22·64	2·013 24·29	2·033 25·84	2·053 27·59	2·070 29·25	2·086 30·93	2·100 32·62	2·113 34·32	2·126 36·02	2·147 39·41	2·167 42·80	2·184 46·19	2·200 49·59
2·6	2·027 20·15	2·054 21·86	2·077 23·57	2·098 25·28	2·118 27·00	2·137 28·72	2·155 30·45	2·172 32·20	2·187 33·95	2·201 35·71	2·213 37·49	2·234 41·01	2·255 44·54	2·273 48·08	2·290 51·62
2·8	2·104 20·91	2·131 22·68	2·155 24·46	2·177 26·24	2·198 28·02	2·218 29·81	2·236 31·61	2·253 33·42	2·268 35·24	2·282 37·07	2·296 38·90	2·318 42·56	2·340 46·23	2·359 49·90	2·377 53·58
3·0	2·180 21·67	2·205 23·50	2·230 25·34	2·253 27·18	2·275 29·02	2·296 30·86	2·315 32·71	2·333 34·58	2·348 36·46	2·363 38·36	2·377 40·26	2·400 44·05	2·422 47·85	2·441 51·65	2·460 55·45

CLASS I. ($n = 0·025.$)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 1·6.

For Bottom-Widths of

Fall per thousand.	7·0	7·5	8·0	8·5	9·0	9·5	10	11	12	13	14	15	16	17	18
0·05	0·321 4·827	0·324 5·143	0·328 5·457	0·331 5·773	0·334 6·085	0·336 6·396	0·338 6·706	0·342 7·335	0·345 7·964	0·348 8·594	0·351 9·225	0·354 9·856	0·357 10·49	0·359 10·63	0·361 11·78
0·1	0·450 6·769	0·454 7·198	0·458 7·628	0·462 8·058	0·466 8·492	0·469 8·930	0·472 9·365	0·477 10·23	0·481 11·10	0·485 11·97	0·489 12·84	0·493 13·72	0·496 14·61	0·499 15·50	0·502 16·39
0·2	0·634 9·535	0·640 10·13	0·645 10·72	0·649 11·32	0·654 11·93	0·659 12·54	0·663 13·15	0·670 14·36	0·676 15·58	0·682 16·81	0·687 18·04	0·692 19·27	0·697 20·52	0·702 21·78	0·706 23·05
0·3	0·776 11·67	0·783 12·40	0·789 13·13	0·795 13·86	0·800 14·59	0·805 15·33	0·810 16·07	0·819 17·56	0·826 19·05	0·833 20·54	0·840 21·05	0·846 23·55	0·851 25·04	0·855 26·53	0·859 28·03
0·4	0·894 13·45	0·902 14·29	0·909 15·13	0·915 15·96	0·921 16·81	0·927 17·66	0·933 18·51	0·943 20·24	0·952 21·97	0·960 23·70	0·968 25·43	0·975 27·15	0·980 28·86	0·985 30·57	0·989 32·28
0·5	1·000 15·04	1·006 15·97	1·014 16·90	1·023 17·84	1·031 18·79	1·037 19·74	1·043 20·69	1·055 22·63	1·064 24·56	1·073 26·49	1·082 28·42	1·090 30·35	1·096 32·27	1·101 34·19	1·106 36·10
0·6	1·095 16·47	1·102 17·50	1·112 18·53	1·121 19·55	1·129 20·59	1·136 21·63	1·143 22·68	1·155 24·79	1·166 26·90	1·176 29·01	1·185 31·11	1·193 33·21	1·199 35·32	1·205 37·43	1·211 39·53
0·7	1·184 17·81	1·191 18·91	1·201 20·01	1·211 21·12	1·219 22·24	1·227 23·36	1·234 24·48	1·248 26·77	1·259 29·06	1·270 31·35	1·280 33·63	1·290 35·91	1·296 38·17	1·302 40·43	1·308 42·70
0·8	1·265 19·02	1·273 20·21	1·284 21·40	1·295 22·58	1·304 23·78	1·312 24·98	1·320 26·19	1·334 28·62	1·346 31·05	1·357 33·48	1·368 35·92	1·378 38·36	1·385 40·79	1·392 43·22	1·398 45·64

0·9	1·341 20·17	1·350 21·43	1·362 22·68	1·373 23·94	1·382 25·22	1·391 26·50	1·400 27·78	1·416 30·37	1·428 32·95	1·440 35·53	1·451 38·11	1·462 40·70	1·469 43·27	1·476 45·84	1·483 48·41
1·0	1·414 21·27	1·423 22·60	1·436 23·93	1·448 25·25	1·458 26·59	1·467 27·93	1·476 29·28	1·491 32·01	1·505 34·73	1·518 37·45	1·530 40·17	1·541 42·90	1·549 45·62	1·557 48·34	1·564 51·05
1·2	1·549 23·30	1·559 24·75	1·572 26·20	1·585 27·64	1·596 29·11	1·606 30·58	1·616 32·06	1·634 35·05	1·649 38·03	1·663 41·01	1·676 44·00	1·688 46·99	1·697 49·96	1·705 52·93	1·713 55·91
1·4	1·671 25·13	1·684 26·71	1·698 28·29	1·712 29·86	1·724 31·45	1·735 33·04	1·746 34·64	1·761 37·87	1·779 41·09	1·796 44·31	1·810 47·53	1·823 50·76	1·832 53·97	1·841 57·18	1·850 60·38
1·6	1·788 26·89	1·800 28·57	1·816 30·25	1·831 31·93	1·843 33·62	1·855 35·32	1·866 37·02	1·886 40·47	1·903 43·92	1·920 47·37	1·935 50·82	1·949 54·26	1·959 57·70	1·969 61·14	1·978 64·57
1·8	1·897 28·53	1·909 30·32	1·927 32·11	1·944 33·90	1·956 35·69	1·968 37·48	1·980 39·28	2·001 42·94	2·019 46·59	2·036 50·24	2·052 53·89	2·067 57·54	2·078 61·19	2·088 64·84	2·098 68·49
2·0	2·000 30·08	2·013 31·96	2·030 33·84	2·047 35·71	2·061 37·61	2·074 39·51	2·087 41·41	2·109 45·27	2·128 49·13	2·146 52·99	2·163 56·84	2·180 60·69	2·191 64·52	2·201 68·34	2·211 72·16
2·2	2·097 31·54	2·111 33·50	2·130 35·47	2·147 37·45	2·161 39·44	2·175 41·43	2·189 43·43	2·212 47·48	2·232 51·52	2·251 55·56	2·269 59·60	2·286 63·64	2·297 67·66	2·303 71·67	2·319 75·68
2·4	2·191 32·95	2·205 34·99	2·224 37·04	2·242 39·10	2·257 41·17	2·272 43·25	2·286 45·35	2·310 49·57	2·331 53·79	2·351 58·01	2·369 62·23	2·387 66·45	2·400 70·65	2·411 74·85	2·422 79·05
2·6	2·280 34·29	2·294 36·42	2·314 38·56	2·334 40·70	2·349 42·85	2·364 45·02	2·379 47·20	2·405 51·59	2·426 55·98	2·447 60·38	2·466 64·78	2·485 69·18	2·497 73·55	2·509 77·92	2·521 82·28
2·8	2·366 35·59	2·381 37·80	2·401 40·01	2·421 42·23	2·438 44·48	2·454 46·73	2·469 48·99	2·495 53·56	2·519 58·12	2·540 62·68	2·560 67·24	2·579 71·80	2·592 76·33	2·604 80·86	2·616 85·39
3·0	2·449 36·83	2·465 39·13	2·486 41·43	2·507 43·72	2·524 46·04	2·540 48·36	2·555 50·69	2·583 55·42	2·607 60·14	2·629 64·86	2·650 69·58	2·669 74·30	2·684 79·00	2·696 83·70	2·708 88·39

CLASS I. ($n = 0·025$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 1·8.

For Bottom-Widths of

Fall per thousand.	9·0	9·5	10	11	12	13	14	15	16	17	18	19	20	21	22
0·05	0·358	0·361	0·364	0·368	0·372	0·376	0·379	0·382	0·385	0·387	0·389	0·391	0·393	0·395	0·396
	7·539	7·930	8·322	9·090	9·860	10·63	11·40	12·17	12·94	13·71	14·49	15·27	16·06	16·84	17·63
0·1	0·498	0·502	0·505	0·511	0·517	0·521	0·525	0·529	0·533	0·537	0·540	0·543	0·545	0·547	0·549
	10·49	11·01	11·54	12·59	13·65	14·71	15·78	16·85	17·92	19·00	20·08	21·17	22·27	23·36	24·46
0·2	0·699	0·704	0·709	0·717	0·725	0·732	0·738	0·743	0·747	0·751	0·755	0·759	0·763	0·767	0·770
	14·72	15·46	16·21	17·70	19·19	20·68	22·17	23·67	25·17	26·67	28·17	29·67	31·17	32·67	34·17
0·3	0·854	0·859	0·864	0·873	0·882	0·890	0·897	0·904	0·911	0·916	0·921	0·926	0·930	0·934	0·937
	17·98	18·86	19·75	21·55	23·36	25·17	26·98	28·80	30·63	32·47	34·31	36·15	38·00	39·85	41·70
0·4	0·984	0·990	0·996	1·007	1·017	1·026	1·034	1·042	1·049	1·055	1·061	1·067	1·071	1·075	1·079
	20·72	21·74	22·77	24·85	26·94	29·03	31·11	33·20	35·30	37·41	39·52	41·64	43·76	45·88	48·00
0·5	1·100	1·107	1·113	1·126	1·138	1·148	1·157	1·165	1·173	1·180	1·186	1·192	1·197	1·202	1·207
	23·16	24·30	25·44	27·77	30·10	32·44	34·78	37·12	39·47	41·83	44·19	46·55	48·91	51·27	53·63
0·6	1·204	1·212	1·219	1·233	1·246	1·257	1·267	1·276	1·285	1·292	1·299	1·306	1·311	1·316	1·321
	25·36	26·61	27·87	30·42	32·98	35·54	38·09	40·65	43·22	45·80	48·38	50·97	53·57	56·17	58·77
0·7	1·301	1·309	1·317	1·332	1·346	1·358	1·369	1·379	1·388	1·396	1·403	1·410	1·416	1·422	1·428
	27·40	28·75	30·11	32·87	35·63	38·40	41·16	43·93	46·70	49·48	52·27	55·06	57·86	60·66	63·46
0·8	1·391	1·400	1·408	1·424	1·439	1·451	1·463	1·474	1·484	1·492	1·500	1·507	1·514	1·520	1·526
	29·30	30·74	32·19	35·13	38·08	41·03	43·99	46·96	49·93	52·91	55·89	58·87	61·86	64·85	67·84

0·9	1·475 31·06	1·484 32·60	1·493 34·13	1·510 37·26	1·526 40·39	1·539 43·53	1·552 46·66	1·563 49·80	1·573 52·95	1·582 56·11	1·591 59·27	1·599 62·44	1·606 65·62	1·613 68·80	1·619 71·98
1·0	1·555 32·75	1·565 34·36	1·574 35·98	1·593 39·27	1·609 42·57	1·623 45·87	1·636 49·17	1·647 52·47	1·658 55·78	1·667 59·11	1·676 62·46	1·685 65·82	1·693 69·18	1·700 72·54	1·707 75·90
1·2	1·703 35·87	1·714 37·64	1·724 39·41	1·744 43·01	1·762 46·62	1·778 50·24	1·792 53·87	1·805 57·50	1·817 61·14	1·827 64·79	1·837 68·45	1·847 72·12	1·855 75·79	1·862 79·46	1·869 83·14
1·4	1·840 38·75	1·851 40·66	1·862 42·57	1·884 46·48	1·904 50·39	1·920 54·30	1·936 58·21	1·950 62·13	1·962 66·05	1·973 69·98	1·984 73·92	1·994 77·88	2·003 81·85	2·011 85·82	2·019 89·80
1·6	1·967 41·43	1·980 43·47	1·991 45·51	2·014 49·66	2·035 53·82	2·053 57·99	2·069 62·17	2·083 66·36	2·097 70·56	2·109 74·77	2·121 78·99	2·132 83·23	2·141 87·48	2·150 91·73	2·158 95·98
1·8	2·087 43·96	2·100 46·12	2·112 48·28	2·137 52·69	2·159 57·11	2·178 61·54	2·195 65·97	2·210 70·41	2·225 74·86	2·237 79·32	2·249 83·80	2·261 88·29	2·271 92·79	2·281 97·29	2·290 101·8
2·0	2·200 46·33	2·213 48·61	2·226 50·89	2·252 55·55	2·276 60·21	2·296 64·88	2·314 69·55	2·330 74·23	2·345 78·92	2·358 83·62	2·371 88·34	2·384 93·07	2·394 97·81	2·404 102·5	2·413 107·2
2·2	2·306 48·56	2·321 50·97	2·335 53·38	2·362 58·26	2·387 63·15	2·408 68·05	2·427 72·95	2·444 77·86	2·460 82·78	2·474 87·72	2·487 92·67	2·500 97·63	2·511 102·6	2·521 107·6	2·531 112·6
2·4	2·409 50·74	2·424 53·24	2·438 55·73	2·466 60·84	2·492 65·96	2·515 71·08	2·535 76·21	2·553 81·34	2·569 86·49	2·584 91·65	2·598 96·82	2·612 102·0	2·623 107·2	2·634 112·4	2·644 117·6
2·6	2·507 52·80	2·523 55·41	2·538 58·02	2·567 63·33	2·594 68·65	2·617 73·98	2·638 79·31	2·657 84·65	2·674 90·00	2·689 95·37	2·704 100·8	2·718 106·2	2·730 111·6	2·741 117·0	2·752 122·4
2·8	2·6[illegible]2 54·80	2·618 57·50	2·634 60·21	2·665 65·72	2·693 71·24	2·716 76·77	2·737 82·30	2·757 87·84	2·775 93·40	2·790 98·97	2·805 104·5	2·820 110·1	2·832 115·7	2·844 121·3	2·855 126·9
3·0	2·693 56·72	2·710 59·53	2·727 62·35	2·759 68·05	2·787 73·76	2·812 79·48	2·834 85·20	2·854 90·93	2·873 96·68	2·889 102·4	2·905 108·2	2·920 114·0	2·932 119·8	2·944 125·6	2·955 131·4

CLASS I. ($n = 0 \cdot 025.$)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 2·0.

For Bottom-Widths of

Fall per thousand.	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
0·05	0·398 11·94	0·402 12·87	0·405 13·80	0·409 14·73	0·412 15·66	0·415 16·60	0·417 17·54	0·420 18·48	0·422 19·42	0·424 20·36	0·426 21·30	0·428 22·24	0·430 23·18	0·431 24·12	0·432 25·06
0·1	0·551 16·53	0·556 17·81	0·560 19·09	0·565 20·38	5·570 21·67	0·574 22·96	0·577 24·25	0·580 25·54	0·582 26·83	0·585 28·12	0·588 29·40	0·590 30·69	0·593 31·99	0·595 33·30	0·597 34·62
0·2	0·771 23·13	0·778 24·92	0·784 26·70	0·790 28·48	0·796 30·26	0·801 32·04	0·805 33·82	0·809 35·60	0·813 37·38	0·816 39·16	0·819 40·95	0·822 42·74	0·825 44·54	0·828 46·34	0·830 48·14
0·3	0·937 28·11	0·946 30·28	0·954 32·46	0·962 34·64	0·969 36·82	0·975 39·00	0·981 41·19	0·986 43·38	0·991 45·57	0·995 47·76	0·999 49·95	1·002 52·14	1·006 54·33	1·009 56·52	1·012 58·70
0·4	1·080 32·40	1·090 34·89	1·099 37·38	1·108 39·88	1·116 42·38	1·122 44·88	1·128 47·39	1·135 49·91	1·141 52·44	1·146 54·97	1·150 57·50	1·154 60·04	1·158 62·60	1·162 65·16	1·166 67·73
0·5	1·208 36·24	1·220 39·03	1·230 41·82	1·239 44·61	1·247 47·40	1·255 50·20	1·262 53·00	1·268 55·80	1·274 58·60	1·279 61·40	1·284 64·20	1·289 67·01	1·294 69·84	1·298 72·68	1·302 75·52
0·6	1·323 39·69	1·335 42·75	1·347 45·81	1·358 48·87	1·368 51·93	1·375 55·00	1·382 58·07	1·389 61·14	1·395 64·21	1·401 67·28	1·407 70·35	1·412 73·43	1·417 76·53	1·422 79·65	1·427 82·77
0·7	1·429 42·87	1·443 46·16	1·455 49·46	1·465 52·76	1·475 56·05	1·484 59·36	1·493 62·68	1·501 66·01	1·508 69·34	1·514 72·67	1·520 76·00	1·526 79·34	1·531 82·68	1·536 86·03	1·541 89·38
0·8	1·528 45·84	1·542 49·35	1·555 52·87	1·566 56·40	1·577 59·94	1·587 63·48	1·596 67·03	1·604 70·58	1·611 74·13	1·618 77·60	1·625 81·25	1·631 84·82	1·637 88·39	1·642 91·96	1·647 95·53

0·9	1·621 48·63	1·636 52·36	1·650 56·09	1·662 59·83	1·673 63·57	1·683 67·32	1·692 71·08	1·701 74·84	1·709 78·61	1·716 82·38	1·723 86·15	1·730 89·91	1·736 93·67	1·742 97·43	1·747 101·2
1·0	1·708 51·24	1·724 55·17	1·739 59·11	1·751 63·06	1·763 67·01	1·774 70·96	1·785 74·92	1·793 78·89	1·801 82·86	1·809 86·83	1·816 90·80	1·823 94·82	1·830 98·81	1·836 102·8	1·842 106·8
1·2	1·872 56·16	1·890 60·46	1·905 64·77	1·919 69·08	1·932 73·40	1·943 77·72	1·954 82·05	1·964 86·40	1·974 90·76	1·982 95·13	1·990 99·50	1·998 103·9	2·005 108·2	2·011 112·6	2·017 117·0
1·4	2·022 60·66	2·041 65·30	2·058 69·95	2·072 74·60	2·085 79·26	2·098 83·92	2·111 88·60	2·122 93·29	2·132 97·99	2·141 102·8	2·150 107·5	2·158 112·2	2·165 116·9	2·172 121·6	2·179 126·4
1·6	2·161 64·83	2·182 69·80	2·200 74·78	2·216 79·77	2·231 84·76	2·244 89·76	2·257 94·77	2·268 99·79	2·279 104·8	2·289 109·8	2·298 114·9	2·307 119·9	2·315 125·0	2·322 130·0	2·329 135·1
1·8	2·292 68·76	2·314 74·03	2·333 79·31	2·350 84·60	2·366 89·90	2·380 95·20	2·394 100·5	2·406 105·8	2·417 111·1	2·427 116·4	2·437 121·8	2·446 127·1	2·451 132·4	2·456 137·6	2·461 142·7
2·0	2·416 72·48	2·439 78·15	2·459 83·73	2·477 89·31	2·494 94·90	2·510 100·4	2·524 106·0	2·536 111·6	2·547 117·2	2·558 122·8	2·569 128·4	2·580 134·0	2·589 139·6	2·597 145·3	2·604 151·0
2·2	2·534 76·02	2·558 81·87	2·579 87·72	2·599 93·58	2·616 99·44	2·632 105·3	2·647 111·2	2·660 117·1	2·673 123·0	2·685 128·9	2·696 134·8	2·705 140·7	2·715 146·6	2·724 152·5	2·732 158·5
2·4	2·647 79·41	2·672 85·94	2·694 91·58	2·714 97·68	2·732 103·8	2·748 109·9	2·764 116·0	2·778 122·1	2·791 128·3	2·803 134·5	2·814 140·7	2·825 146·8	2·834 153·0	2·843 159·2	2·852 165·4
2·6	2·775 82·65	2·781 89·00	2·804 95·35	2·825 101·7	2·843 108·0	2·861 114·4	2·877 120·8	2·892 127·2	2·906 133·6	2·918 140·0	2·929 146·4	2·940 152·8	2·950 159·3	2·960 165·8	2·970 172·3
2·8	2·858 85·74	2·885 92·35	2·910 98·96	2·931 105·6	2·951 112·2	2·969 118·8	2·986 125·4	3·000 132·0	3·014 138·6	3·027 145·3	3·040 152·0	3·052 158·6	3·062 165·3	3·072 172·0	3·081 178·7
3·0	2·960 88·80	2·987 95·62	3·012 102·4	3·034 109·2	3·054 116·0	3·073 122·9	3·091 129·8	3·106 136·6	3·120 143·5	3·134 150·4	3·147 157·3	3·160 164·2	3·171 171·1	3·181 178·0	3·190 185·0

CLASS I. ($n = 0 \cdot 025$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 2·2.

For Bottom-Widths of

Fall per thousand.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0·05	0·436 18·51	0·439 19·63	0·442 20·75	0·445 21·87	0·448 22·99	0·451 24·11	0·453 25·22	0·455 26·33	0·456 27·44	0·458 28·55	0·460 29·65	0·462 30·75	0·463 31·85	0·464 32·95	0·465 34·06
0·1	0·602 25·56	0·607 27·09	0·611 28·62	0·614 30·15	0·617 31·68	0·621 33·20	0·624 34·72	0·627 36·24	0·629 37·76	0·631 39·28	0·633 40·80	0·635 42·32	0·637 43·84	0·639 45·36	0·640 46·88
0·2	0·837 35·54	0·843 37·64	0·848 39·74	0·853 41·84	0·857 43·94	0·861 46·03	0·865 48·15	0·869 50·27	0·872 52·40	0·876 54·53	0·879 56·66	0·882 58·80	0·885 60·95	0·888 63·11	0·891 65·27
0·3	1·017 43·18	1·025 45·75	1·032 48·32	1·038 50·89	1·043 53·46	1·048 56·03	1·052 58·60	1·057 61·17	1·061 63·75	1·065 66·33	1·069 68·91	1·073 71·50	1·076 74·09	1·079 76·68	1·082 79·27
0·4	1·175 49·89	1·183 52·85	1·191 55·81	1·198 58·77	1·204 61·73	1·210 64·69	1·215 67·65	1·220 70·61	1·225 73·56	1·229 76·51	1·233 79·47	1·236 82·44	1·240 85·41	1·244 88·38	1·247 91·35
0·5	1·312 55·71	1·321 59·01	1·329 62·31	1·337 65·60	1·344 68·89	1·350 72·18	1·355 75·47	1·360 78·76	1·365 82·05	1·370 85·34	1·375 88·63	1·379 91·92	1·383 95·21	1·387 98·50	1·390 101·8
0·6	1·437 61·01	1·447 64·61	1·456 68·21	1·464 71·81	1·472 75·41	1·478 79·01	1·484 82·63	1·490 86·24	1·496 89·85	1·501 93·46	1·506 97·07	1·510 100·7	1·514 104·3	1·518 107·9	1·522 111·5
0·7	1·553 65·93	1·563 69·82	1·573 73·71	1·582 77·60	1·590 81·49	1·597 85·37	1·603 89·26	1·609 93·14	1·615 97·02	1·621 100·9	1·626 104·8	1·631 108·7	1·636 112·6	1·640 116·5	1·644 120·4
0·8	1·660 70·49	1·671 74·65	1·681 78·81	1·791 82·97	1·700 87·12	1·707 91·27	1·714 95·43	1·721 99·59	1·727 103·8	1·733 108·0	1·739 112·1	1·744 116·2	1·749 120·4	1·754 124·6	1·758 128·8

0·9	1·760 74·73	1·772 79·15	1·783 83·57	1·793 87·99	1·803 92·40	1·811 96·81	1·818 101·2	1·825 105·6	1·831 110·0	1·838 114·4	1·844 118·8	1·850 123·2	1·855 127·6	1·860 132·0	1·864 136·5
1·0	1·856 78·81	1·868 83·44	1·880 88·08	1·890 92·72	1·900 97·36	1·909 102·0	1·917 106·6	1·923 111·2	1·928 115·8	1·935 120·5	1·942 125·2	1·949 129·8	1·955 134·5	1·960 139·2	1·965 143·9
1·2	2·033 86·32	2·046 91·41	2·059 96·50	2·071 101·6	2·082 106·7	2·091 111·8	2·100 116·9	2·108 122·0	2·115 127·1	2·122 132·2	2·129 137·2	2·136 142·3	2·142 147·4	2·147 152·5	2·152 157·6
1·4	2·196 93·24	2·210 98·73	2·224 104·2	2·237 109·7	2·249 115·2	2·258 120·7	2·267 126·2	2·276 131·7	2·285 137·2	2·293 142·7	2·300 148·2	2·307 153·7	2·313 159·2	2·319 164·7	2·325 170·3
1·6	2·348 99·70	2·363 105·6	2·377 111·4	2·391 117·2	2·404 123·1	2·414 129·0	2·424 134·8	2·433 140·7	2·442 146·6	2·450 152·5	2·458 158·4	2·466 164·3	2·473 170·2	2·479 176·1	2·485 182·0
1·8	2·490 105·7	2·507 112·0	2·522 118·3	2·536 124·5	2·550 130·7	2·561 136·9	2·571 143·2	2·581 149·5	2·591 155·7	2·600 161·9	2·608 168·1	2·616 174·3	2·623 180·5	2·630 186·8	2·636 193·1
2·0	2·624 111·4	2·641 117·9	2·658 124·5	2·673 131·1	2·687 137·7	2·699 144·3	2·710 150·9	2·720 157·5	2·730 164·1	2·739 170·7	2·748 177·2	2·757 183·8	2·765 190·4	2·772 197·0	2·779 203·6
2·2	2·752 116·8	2·770 123·7	2·788 130·6	2·804 137·5	2·819 144·4	2·831 151·3	2·843 158·2	2·854 165·1	2·864 172·0	2·874 178·9	2·883 185·8	2·892 192·7	2·900 199·6	2·908 206·5	2·915 213·5
2·4	2·875 122·1	2·894 129·3	2·912 136·5	2·928 143·7	2·944 150·9	2·956 158·1	2·968 165·3	2·980 172·5	2·991 179·7	3·001 186·9	3·011 194·1	3·021 201·3	3·029 208·5	3·037 215·7	3·044 223·0
2·6	2·992 127·0	3·012 134·5	3·031 142·0	3·048 149·5	3·064 157·0	3·077 164·5	3·090 172·0	3·102 179·5	3·113 187·0	3·124 194·5	3·134 202·0	3·144 209·5	3·152 217·0	3·160 224·5	3·168 232·1
2·8	3·105 131·8	3·126 139·5	3·145 147·3	3·163 155·1	3·180 162·9	3·194 170·7	3·207 178·4	3·219 186·2	3·231 194·0	3·242 201·8	3·252 209·6	3·262 217·4	3·271 225·2	3·280 233·0	3·288 240·9
3·0	3·215 136·5	3·234 144·5	3·257 152·5	3·275 160·5	3·292 168·5	3·304 176·6	3·319 184·6	3·332 192·7	3·344 200·8	3·355 208·9	3·366 217·0	3·377 225·1	3·386 233·2	3·395 241·2	3·403 249·3

CLASS I. ($n = 0{\cdot}025$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 2·4.

For Bottom-Widths of

Fall per thousand.	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
0·05	0·474 26·85	0·477 28·13	0·479 29·42	0·481 30·71	0·483 32·00	0·485 33·29	0·487 34·59	0·489 35·90	0·491 37·21	0·493 38·52	0·494 39·83	0·495 41·12	0·496 42·40	0·497 43·67	0·498 44·94
0·1	0·652 36·93	0·655 38·68	0·658 40·43	0·661 42·19	0·663 43·95	0·666 45·71	0·668 47·47	0·670 49·23	0·672 50·99	0·674 52·75	0·676 54·51	0·678 56·28	0·680 58·06	0·682 59·84	0·683 61·63
0·2	1·904 51·20	0·908 53·63	0·912 56·06	0·916 58·49	0·920 60·92	0·923 63·36	0·926 65·81	0·930 68·28	0·933 70·75	0·936 73·23	0·939 75·72	0·941 78·19	0·943 80·63	0·945 83·06	0·947 85·45
0·3	1·100 62·30	1·105 65·25	1·110 68·20	1·115 71·16	1·119 74·12	1·123 77·08	1·127 80·03	1·130 82·98	1·133 85·94	1·136 88·90	1·139 91·86	1·142 94·83	1·145 97·81	1·148 100·8	1·151 103·8
0·4	1·267 71·76	1·273 75·18	1·279 78·60	1·285 82·02	1·290 85·45	1·295 88·88	1·299 92·39	1·302 95·79	1·305 99·19	1·309 102·5	1·313 105·9	1·316 109·3	1·319 112·7	1·322 116·1	1·325 119·6
0·5	1·411 79·91	1·417 83·69	1·423 87·47	1·429 91·25	1·435 95·04	1·440 98·83	1·445 102·6	1·450 106·3	1·454 110·1	1·458 113·9	1·462 117·7	1·466 121·5	1·469 125·3	1·472 129·1	1·475 133·0
0·6	1·545 87·50	1·552 91·65	1·559 95·81	1·566 100·0	1·572 104·2	1·578 108·3	1·583 112·5	1·588 116·7	1·593 120·9	1·598 125·1	1·602 129·2	1·606 133·4	1·610 137·6	1·614 141·8	1·617 145·9
0·7	1·669 94·54	1·677 99·01	1·684 103·5	1·691 107·9	1·698 112·4	1·704 116·9	1·710 121·4	1·715 125·9	1·720 130·4	1·725 134·9	1·730 139·4	1·734 143·9	1·738 148·4	1·742 152·9	1·746 157·5
0·8	1·785 101·1	1·793 105·8	1·801 110·6	1·809 115·4	1·816 120·2	1·822 125·0	1·828 129·8	1·834 134·6	1·839 139·4	1·844 144·2	1·849 149·1	1·854 153·9	1·858 158·7	1·862 163·5	1·866 1·684

0·9	1·893 107·2	1·902 112·2	1·910 117·3	1·918 122·4	1·925 127·5	1·932 132·6	1·938 137·7	1·944 142·8	1·950 147·9	1·956 152·0	1·962 158·2	1·967 163·3	1·972 168·4	1·976 173·5	1·980 178·7
1·0	1·995 113·0	2·004 118·3	2·012 123·6	2·021 129·0	2·030 134·4	2·037 139·8	2·043 145·1	2·049 150·5	2·055 155·9	2·061 161·3	2·067 166·7	2·073 172·1	2·078 177·5	2·083 182·9	2·087 188·3
1·2	2·186 123·8	2·196 129·6	2·205 135·4	2·214 141·3	2·223 147·2	2·231 153·1	2·238 158·9	2·245 164·8	2·251 170·7	2·258 176·6	2·264 182·5	2·270 188·4	2·276 194·3	2·281 200·3	2·286 206·3
1·4	2·361 133·7	2·372 140·0	2·382 146·3	2·392 152·6	2·402 159·0	2·410 165·4	2·418 171·7	2·425 178·0	2·432 184·4	2·439 190·8	2·446 197·2	2·453 203·6	2·459 210·0	2·464 216·4	2·469 222·8
1·6	2·524 143·0	2·535 149·7	2·546 156·5	2·557 163·3	2·568 170·1	2·577 176·9	2·585 183·7	2·593 190·5	2·600 197·3	2·608 204·1	2·615 210·9	2·622 217·7	2·628 224·5	2·634 231·3	2·640 238·2
1·8	2·677 151·6	2·689 158·8	2·701 166·0	2·712 173·2	2·723 180·4	2·733 187·6	2·742 194·8	2·750 202·0	2·758 209·2	2·766 216·4	2·774 223·7	2·781 230·9	2·788 238·1	2·794 245·3	2·800 252·6
2·0	2·822 159·8	2·835 167·4	2·847 175·0	2·859 182·6	2·870 190·2	2·880 197·8	2·890 205·4	2·899 213·0	2·908 220·6	2·916 228·2	2·924 235·8	2·932 243·4	2·939 251·0	2·945 258·6	2·951 266·3
2·2	2·960 167·6	2·973 175·5	2·986 183·4	2·998 191·3	3·010 199·3	3·021 207·3	3·031 215·3	3·040 223·3	3·049 231·3	3·058 239·3	3·067 247·3	3·075 255·3	3·082 263·3	3·089 271·3	3·095 279·3
2·4	3·091 175·1	3·105 183·4	3·118 191·7	3·131 200·0	3·144 208·3	3·155 216·6	3·165 224·9	3·175 233·2	3·185 241·5	3·194 249·9	3·203 258·3	3·212 266·6	3·219 274·9	3·226 283·3	3·232 291·7
2·6	3·217 182·2	3·232 190·8	3·246 199·4	3·260 208·0	3·273 216·7	3·284 225·4	3·295 234·0	3·305 242·7	3·315 251·4	3·325 260·1	3·334 268·6	3·343 277·5	3·351 286·2	3·358 294·9	3·365 303·7
2·8	3·338 189·1	3·353 198·0	3·268 207·0	3·383 216·0	3·397 225·0	3·409 234·0	3·419 243·0	3·430 252·0	3·440 261·0	3·450 270·0	3·459 278·9	3·468 288·0	3·476 297·0	3·484 306·0	3·492 315·1
3·0	3·456 195·7	3·472 205·0	3·487 214·3	3·502 223·6	3·516 232·9	3·528 242·2	3·539 251·5	3·550 260·8	3·561 270·1	3·571 279·4	3·581 288·8	3·590 298·1	3·598 307·4	3·606 316·7	3·614 326·1

CLASS I. ($n = 0{\cdot}025$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 2·6.

For Bottom-Widths of

Fall per thousand.	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
0·05	0·513 39·89	0·515 41·41	0·517 42·93	0·519 44·44	0·521 45·95	0·523 47·46	0·524 48·95	0·526 50·44	0·527 51·92	0·528 53·40	0·529 54·88	0·530 56·37	0·531 57·86	0·532 59·35	0·533 60·84
0·1	0·702 54·58	0·705 56·63	0·707 58·67	0·710 60·71	0·712 62·75	0·714 64·79	0·715 66·81	0·717 68·83	0·718 70·85	0·720 72·88	0·722 74·91	0·724 76·95	0·726 78·99	0·727 81·04	0·728 83·10
0·2	0·972 75·56	0·975 78·34	0·978 81·12	0·981 83·90	0·983 86·68	0·986 89·47	0·988 92·25	0·991 95·03	0·993 97·82	0·996 100·6	0·998 103·4	1·000 106·2	1·002 109·0	1·003 111·8	1·004 114·6
0·3	1·183 91·96	1·187 95·34	1·191 98·73	1·194 102·1	1·197 105·5	1·200 108·9	1·203 112·3	1·206 115·7	1·208 119·1	1·211 122·5	1·214 125·9	1·216 129·3	1·218 132·7	1·220 136·1	1·221 139·5
0·4	1·360 105·7	1·364 109·6	1·368 113·5	1·372 117·4	1·376 121·3	1·380 125·2	1·383 129·1	1·386 133·0	1·389 136·9	1·393 140·8	1·396 144·7	1·399 148·6	1·401 152·5	1·403 156·4	1·404 160·2
0·5	1·514 117·7	1·519 122·1	1·523 126·5	1·527 130·8	1·531 135·1	1·535 139·4	1·539 143·8	1·543 148·2	1·547 152·5	1·550 156·8	1·553 161·1	1·556 165·5	1·559 169·8	1·561 174·1	1·563 178·4
0·6	1·659 129·0	1·664 133·7	1·668 138·4	1·673 143·1	1·677 147·8	1·681 152·6	1·685 157·3	1·689 162·0	1·693 166·7	1·697 171·5	1·700 176·3	1·703 181·0	1·706 185·8	1·709 190·6	1·712 195·4
0·7	1·792 139·3	1·796 144·4	1·800 149·5	1·805 154·6	1·810 159·7	1·815 164·8	1·820 169·9	1·825 175·0	1·830 180·1	1·833 185·2	1·836 190·4	1·839 195·5	1·843 200·7	1·846 205·8	1·849 211·0
0·8	1·915 148·9	1·921 154·4	1·927 159·9	1·932 165·4	1·936 170·8	1·941 176·2	1·946 181·7	1·950 187·2	1·954 192·7	1·958 198·1	1·962 203·5	1·965 209·0	1·968 214·5	1·971 219·9	1·974 225·3

0·9	2·031 157·9	2·037 163·7	2·043 169·5	2·049 175·3	2·054 181·1	2·059 186·9	2·064 192·7	2·069 198·5	2·073 204·3	2·077 210·1	2·081 215·9	2·084 221·7	2·088 227·5	2·091 233·3	2·094 239·0
1·0	2·141 166·4	2·148 172·5	2·154 178·6	2·160 184·7	2·165 190·8	2·170 196·9	2·175 203·0	2·180 209·1	2·185 215·2	2·189 221·3	2·193 227·5	2·197 233·6	2·201 239·7	2·204 245·8	2·207 251·9
1·2	2·345 182·3	2·352 189·0	2·359 195·7	2·361 202·4	2·371 209·1	2·378 215·8	2·384 222·5	2·389 229·2	2·393 235·9	2·398 242·6	2·403 249·3	2·407 256·0	2·411 262·7	2·415 269·4	2·418 276·0
1·4	2·533 196·9	2·541 204·1	2·548 211·3	2·555 218·5	2·562 225·7	2·568 233·0	2·574 240·2	2·580 247·4	2·585 254·6	2·590 261·9	2·595 269·2	2·599 276·4	2·604 283·6	2·608 290·8	2·612 298·1
1·6	2·708 210·5	2·716 218·2	2·724 225·9	2·732 233·6	2·739 241·3	2·746 249·1	2·752 256·8	2·758 264·5	2·764 272·2	2·769 280·0	2·774 287·7	2·778 295·5	2·783 303·2	2·787 310·9	2·791 318·6
1·8	2·872 223·3	2·881 231·4	2·889 239·6	2·897 247·8	2·905 256·0	2·912 264·2	2·919 272·4	2·925 280·6	2·931 288·8	2·937 297·0	2·942 305·2	2·947 313·4	2·952 321·6	2·957 329·8	2·961 338·0
2·0	3·028 235·4	3·037 244·1	3·046 252·8	3·054 261·4	2·062 270·0	3·070 278·6	3·077 287·3	3·084 296·0	3·090 304·6	3·096 313·2	3·102 321·8	3·107 330·4	3·112 339·0	3·117 347·6	3·121 356·2
2·2	3·175 246·8	3·185 255·9	3·194 265·0	3·203 274·1	3·211 283·1	3·219 292·1	3·226 301·2	3·233 310·3	3·240 319·4	3·246 328·4	3·252 337·4	3·258 346·4	3·264 355·5	3·269 364·6	3·274 373·7
2·4	3·317 257·9	3·327 267·3	3·337 276·7	3·346 286·1	3·354 295·6	3·363 305·1	3·371 314·5	3·378 324·0	3·385 333·4	3·391 342·9	3·397 352·4	3·403 361·8	3·409 371·3	3·414 380·7	3·419 390·2
2·6	3·452 268·3	3·463 278·2	3·473 288·1	3·482 298·0	3·491 307·8	3·500 317·6	3·508 327·5	3·516 337·4	3·523 347·3	3·530 357·1	3·537 366·9	3·543 376·8	3·549 386·6	3·554 396·4	3·559 406·2
2·8	3·583 278·5	3·594 288·7	3·604 298·9	3·614 309·1	3·623 319·3	3·632 329·5	3·640 339·7	3·648 349·9	3·656 360·1	3·663 370·4	3·669 380·6	3·675 390·9	3·681 401·1	3·687 411·3	3·693 421·5
3·0	3·709 288·3	3·720 298·9	3·730 309·5	3·740 320·1	3·750 330·7	3·759 341·2	3·768 351·8	3·777 362·4	3·785 373·0	3·792 383·6	3·799 394·1	3·805 404·7	3·811 415·3	3·817 425·8	3·823 436·3

CLASS I. ($n = 0\cdot025.$)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 2·8.

For Bottom-Widths of

Fall per thousand.	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
0·05	0·552 59·05	0·553 60·74	0·554 62·43	0·555 64·12	0·557 65·81	0·558 67·50	0·559 69·19	0·560 70·88	0·561 72·58	0·562 74·28	0·563 75·98	0·564 77·69	0·565 79·41	0·566 81·14	0·567 82·87
0·1	0·754 80·65	0·756 82·92	0·757 85·20	0·758 87·48	0·760 89·76	0·761 92·05	0·762 94·35	0·764 96·66	0·766 98·97	0·767 101·3	0·769 103·6	0·770 106·0	0·771 108·3	0·772 110·7	0·773 113·0
0·2	1·037 110·9	1·039 114·0	1·041 117·1	1·043 120·2	1·045 123·4	1·047 126·6	1·049 129·8	1·051 133·0	1·053 136·2	1·055 139·4	1·057 142·6	1·059 145·8	1·061 149·1	1·063 152·4	1·065 155·7
0·3	1·262 135·0	1·265 138·8	1·268 142·6	1·270 146·4	1·273 150·3	1·275 154·2	1·277 158·1	1·280 162·0	1·282 165·9	1·284 169·8	1·287 173·7	1·289 177·6	1·291 181·5	1·293 185·4	1·295 189·3
0·4	1·451 155·2	1·455 159·6	1·458 164·0	1·461 168·4	1·464 172·9	1·467 177·4	1·470 181·9	1·473 186·4	1·475 190·9	1·477 195·3	1·480 199·7	1·482 204·2	1·484 208·6	1·486 213·1	1·488 217·5
0·5	1·616 172·8	1·619 177·8	1·622 182·7	1·625 187·6	1·628 192·5	1·631 197·4	1·634 202·4	1·637 207·3	1·640 212·2	1·642 217·1	1·645 222·0	1·647 226·9	1·649 231·8	1·651 236·7	1·653 241·6
0·6	1·766 188·9	1·770 194·3	1·773 199·7	1·776 205·1	1·780 210·5	1·783 215·8	1·786 221·2	1·790 226·6	1·793 232·0	1·796 237·4	1·799 242·7	1·801 248·0	1·803 253·4	1·805 258·8	1·807 264·1
0·7	1·906 203·8	1·910 209·6	1·914 215·4	1·917 221·2	1·921 227·0	1·925 232·9	1·928 238·7	1·932 244·5	1·935 250·3	1·938 256·1	1·942 262·0	1·945 267·8	1·948 273·7	1·951 279·6	1·954 285·5
0·8	2·034 217·6	2·039 223·8	2·043 230·0	2·047 236·2	2·051 242·4	2·055 248·6	2·059 254·8	2·063 261·0	2·066 267·2	2·069 273·4	2·072 279·6	2·075 285·8	2·078 292·0	2·081 298·3	2·084 304·6

0·9	2·157 230·7	2·162 237·3	2·167 243·9	2·171 250·5	2·176 257·1	2·180 263·7	2·184 270·3	2·188 276·9	2·191 283·5	2·194 290·0	2·197 296·5	2·200 303·1	2·203 309·7	2·206 316·3	2·209 322·8
1·0	2·273 243·1	2·278 250·1	2·283 257·1	2·288 264·1	2·293 271·0	2·297 277·9	2·301 284·9	2·305 291·9	2·309 298·9	2·313 305·8	2·317 312·7	2·320 319·7	2·323 326·7	2·326 333·6	2·329 340·5
1·2	2·491 266·3	2·496 274·0	2·501 281·6	2·506 289·2	2·511 296·8	2·516 304·4	2·521 312·1	2·526 319·8	2·531 327·4	2·535 335·0	2·539 342·6	2·542 350·2	2·545 357·8	2·548 365·4	2·551 372·9
1·4	2·690 287·7	2·696 296·0	2·702 304·2	2·707 312·4	2·713 320·6	2·718 328·8	2·723 337·0	2·728 345·3	2·733 353·5	2·737 361·7	2·741 369·9	2·745 378·1	2·749 386·3	2·752 394·5	2·755 402·7
1·6	2·876 307·5	2·882 316·3	2·888 325·1	2·894 333·9	2·900 342·7	2·906 351·5	2·911 360·3	2·916 369·1	2·921 377·9	2·926 386·7	2·930 395·5	2·934 404·3	2·938 413·1	2·942 421·9	2·946 430·6
1·8	3·051 326·3	3·058 335·7	3·065 345·0	3·071 354·3	3·077 363·6	3·083 372·9	3·088 382·3	3·093 391·6	3·098 400·9	3·103 410·2	3·108 419·5	3·112 428·8	3·116 438·1	3·120 447·4	3·124 456·7
2·0	3·215 343·9	3·223 353·8	3·230 363·6	3·237 373·4	3·243 383·2	3·249 393·0	3·255 402·9	3·261 412·7	3·266 422·5	3·271 432·3	3·276 442·0	3·281 452·0	3·285 461·8	3·290 471·6	3·294 481·4
2·2	3·373 360·7	3·381 371·0	3·388 381·3	3·395 391·6	3·402 401·9	3·408 412·2	3·414 422·5	3·420 432·8	3·426 443·1	3·431 453·4	3·436 463·7	3·441 474·0	3·445 484·3	3·450 494·6	3·454 504·8
2·4	3·523 376·8	3·531 387·5	3·539 398·2	3·546 408·9	3·553 419·7	3·559 430·5	3·565 441·2	3·571 451·9	3·577 462·6	3·583 473·4	3·588 484·2	3·593 495·0	3·598 505·8	3·603 516·6	3·608 527·4
2·6	3·666 392·1	3·675 403·3	3·683 414·5	3·691 425·7	3·698 436·9	3·705 448·1	3·711 459·3	3·718 470·5	3·724 481·7	3·730 492·9	3·736 504·2	3·741 515·4	3·746 526·6	3·751 537·8	3·756 549·0

CLASS I. ($n = 0 \cdot 025$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 3·0.

For Bottom-Widths of

Fall per thousand.	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
0·05	0·570 73·54	0·572 75·45	0·573 77·36	0·574 79·26	0·576 81·16	0·577 83·06	0·578 84·96	0·579 86·86	0·580 88·75	0·581 90·64	0·582 92·53	0·583 94·42	0·584 96·31	0·585 98·21	0·586 100·1
0·1	0·776 100·1	0·778 102·7	0·780 105·3	0·781 107·9	0·783 110·5	0·785 113·0	0·786 115·6	0·788 118·2	0·789 120·8	0·790 123·4	0·792 125·9	0·793 128·5	0·794 131·0	0·795 133·6	0·796 136·1
0·2	1·067 137·6	1·070 141·1	1·072 144·6	1·074 148·2	1·077 151·8	1·079 155·4	1·081 159·0	1·083 162·6	1·085 166·2	1·087 169·7	1·089 173·2	1·091 176·8	1·093 180·4	1·095 184·0	1·097 187·6
0·3	1·299 167·6	1·302 172·0	1·305 176·3	1·308 180·6	1·311 184·9	1·314 189·2	1·317 193·6	1·320 197·9	1·322 202·2	1·324 206·5	1·326 210·8	1·328 215·2	1·330 219·5	1·332 223·8	1·334 228·1
0·4	1·492 192·5	1·496 197·4	1·499 202·3	1·502 207·2	1·505 212·2	1·508 217·2	1·511 222·1	1·514 227·0	1·517 232·0	1·519 237·0	1·522 242·0	1·524 247·0	1·526 252·0	1·528 256·9	1·530 261·8
0·5	1·661 214·3	1·665 219·8	1·669 225·3	1·672 230·8	1·676 236·3	1·679 241·8	1·682 247·3	1·685 252·8	1·688 258·3	1·691 263·8	1·694 269·3	1·697 274·8	1·699 280·3	1·702 285·8	1·704 291·4
0·6	1·815 234·1	1·819 240·1	1·823 246·1	1·827 252·1	1·831 258·1	1·835 264·2	1·838 270·2	1·842 276·2	1·845 282·2	1·848 288·2	1·851 294·3	1·854 300·3	1·857 306·4	1·860 312·5	1·863 318·6
0·7	1·961 253·0	1·966 259·4	1·970 265·9	1·974 272·4	1·978 278·9	1·982 285·4	1·986 291·8	1·990 298·3	1·993 304·8	1·996 311·3	1·999 317·8	2·002 324·3	2·005 330·8	2·008 337·3	2·011 343·9
0·8	2·096 270·4	2·101 277·3	2·106 284·2	2·110 291·1	2·115 298·1	2·119 305·1	2·123 312·0	2·127 318·9	2·131 325·8	2·134 332·8	2·138 339·8	2·141 346·7	2·144 353·7	2·147 360·6	2·150 367·6

0·9	2·223 286·7	2·228 294·1	2·233 301·5	2·238 308·9	2·243 316·1	2·248 323·7	2·252 331·1	2·256 338·5	2·260 345·9	2·264 353·3	2·268 360·6	2·271 368·0	2·274 375·3	2·277 382·6	2·280 389·9
1·0	2·343 302·3	2·349 310·1	2·354 317·9	2·359 325·7	2·364 333·4	2·369 341·1	2·374 348·9	2·378 356·7	2·382 364·5	2·386 372·2	2·390 379·9	2·394 387·7	2·397 395·4	2·400 403·2	2·403 410·9
1·2	2·567 331·1	2·573 339·7	2·579 348·2	2·584 356·7	2·590 365·2	2·595 373·7	2·600 382·3	2·605 390·8	2·610 399·3	2·614 407·8	2·618 416·3	2·622 424·7	2·625 433·1	2·628 441·5	2·631 449·9
1·4	2·773 357·7	2·779 366·9	2·785 376·1	2·791 385·3	2·797 394·5	2·803 403·7	2·809 412·9	2·814 422·1	2·819 431·3	2·823 440·5	2·828 449·7	2·832 458·9	2·836 468·1	2·840 477·2	2·844 486·3
1·6	2·964 382·4	2·971 392·3	2·978 402·2	2·984 412·0	2·991 421·8	2·997 431·6	3·003 441·5	3·009 451·4	3·014 461·2	3·019 471·0	3·024 480·8	3·028 490·6	3·032 500·4	3·036 510·2	3·040 520·0
1·8	3·144 405·6	3·151 416·0	3·158 426·4	3·165 436·8	3·172 447·2	3·178 457·6	3·184 468·1	3·190 478·5	2·126 488·5	3·201 499·3	3·206 509·7	3·211 520·1	3·216 530·5	3·220 540·9	3·224 551·3
2·0	3·314 427·5	3·322 438·5	3·329 449·5	3·336 460·5	3·343 471·5	3·350 482·4	3·357 493·4	3·363 504·4	3·369 515·4	3·375 526·4	3·380 537·3	3·385 548·3	3·390 559·2	3·394 570·1	3·398 581·0
2·2	3·476 448·4	3·484 460·0	3·492 471·5	3·500 483·0	3·507 494·5	3·514 506·0	3·521 517·6	3·527 529·1	3·533 540·6	3·539 552·1	3·545 563·6	3·550 575·2	3·555 586·7	3·560 598·2	3·565 609·7

CLASS I. (n = 0·025.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 3·5.

For Bottom-Widths of

Fall per thousand.	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72
0·05	0·652 112·4	0·655 117·5	0·657 122·5	0·659 127·5	0·661 132·5	0·663 137·5	0·664 142·5	0·666 147·5	0·668 152·5	0·669 157·5	0·670 162·4	0·671 167·4	0·672 172·3	0·673 177·2	0·674 182·2
0·1	0·880 151·7	0·883 158·5	0·886 165·2	0·888 171·9	0·891 178·6	0·893 185·3	0·895 192·0	0·897 198·7	0·899 205·4	0·901 212·1	0·903 218·8	0·904 225·4	0·905 232·0	0·906 238·6	0·907 245·2
0·2	1·205 207·7	1·209 216·9	1·213 226·1	1·216 235·3	1·219 244·4	1·222 253·5	1·225 262·7	1·228 271·9	1·231 281·0	1·233 290·1	1·235 299·2	1·237 308·3	1·239 317·4	1·240 326·5	1·241 335·5
0·3	1·465 252·5	1·470 263·7	1·474 274·9	1·478 286·0	1·482 297·1	1·486 308·2	1·490 319·4	1·493 330·6	1·496 341·7	1·499 352·8	1·502 363·9	1·504 375·0	1·506 386·1	1·508 397·2	1·510 408·3
0·4	1·681 289·7	1·687 302·5	1·692 315·3	1·697 328·1	1·702 340·9	1·706 353·7	1·710 366·5	1·714 379·3	1·717 392·1	1·720 404·9	1·723 417·6	1·726 430·4	1·729 443·2	1·732 456·0	1·734 468·8
0·5	1·869 322·2	1·875 336·3	1·880 350·4	1·885 364·6	1·890 378·8	1·895 393·0	1·900 407·2	1·904 421·4	1·908 435·6	1·911 449·8	1·915 464·1	1·918 478·3	1·921 492·5	1·924 506·7	1·927 521·0
0·6	2·042 352·0	2·049 367·4	2·055 382·9	2·061 398·4	2·066 413·9	2·071 429·4	2·076 444·9	2·081 460·4	2·085 475·9	2·089 491·5	2·093 507·1	2·097 522·6	2·100 538·2	2·103 553·8	2·106 569·4
0·7	2·202 379·6	2·209 396·2	2·215 412·9	2·221 429·6	2·227 446·3	2·233 463·0	2·238 479·7	2·243 496·4	2·248 513·1	2·252 529·9	2·256 546·7	2·260 563·4	2·263 580·1	2·266 596·8	2·269 613·5
0·8	2·349 404·9	2·356 422·8	2·363 440·6	2·369 458·4	2·376 476·2	2·382 494·0	2·388 511·9	2·393 529·8	2·398 547·7	2·402 565·6	2·407 583·5	2·411 601·4	2·415 619·3	2·419 637·2	2·423 655·1

0·9	2·486 428·5	2·494 437·3	2·501 456·1	2·508 475·0	2·515 493·9	5·521 522·8	2·527 541·7	2·532 560·6	2·537 579·5	2·542 598·4	2·547 617·3	2·551 636·2	2·555 655·1	2·559 674·0	2·563 693·0
1·0	2·620 451·6	2·628 471·6	2·636 491·5	2·644 511·4	2·651 531·3	2·658 551·2	2·664 571·2	2·670 591·1	2·675 610·0	2·680 630·9	2·685 650·8	2·690 670·8	2·694 690·7	2·698 710·6	2·702 730·5
1·2	2·871 494·9	2·880 516·6	2·889 538·8	2·897 560·1	2·904 581·9	2·911 603·7	2·918 625·5	2·924 647·3	2·930 669·1	2·935 691·0	2·941 712·9	2·946 734·8	2·951 756·7	2·956 778·6	2·961 800·6
1·4	3·100 534·8	3·110 557·8	3·120 581·4	3·129 605·0	3·137 628·6	3·145 652·2	3·152 675·7	3·159 699·3	3·165 722·9	3·171 746·5	3·177 770·1	3·183 793·7	3·188 817·8	3·193 840·9	3·198 864·6
1·6	3·314 571·2	3·325 596·3	3·335 621·5	3·345 646·7	3·354 671·9	3·362 697·1	3·370 722·2	3·377 747·4	3·384 772·6	3·390 797·8	3·396 823·0	3·402 848·2	3·407 873·4	3·412 898·6	3·417 923·9
1·8	3·515 605·9	3·527 632·6	3·538 659·3	3·548 686·0	3·557 712·7	3·566 739·4	3·574 766·1	3·581 792·8	3·588 819·5	3·595 846·2	3·602 873·0	3·608 899·8	3·614 926·6	3·620 953·4	3·625 980·2
2·0	3·706 638·9	3·718 667·0	3·729 695·1	3·739 723·2	3·749 751·3	3·759 779·5	3·768 807·6	3·776 835·7	3·783 863·8	3·790 891·0	3·797 920·2	3·804 948·4	3·810 976·6	3·816 1005	3·822 1033

CLASS I. (n = 0·025.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 4·0.

Fall per thousand.	For Bottom-Widths of														
	47	50	53	56	59	62	65	68	71	74	77	80	83	86	89
0·05	0·712	0·716	0·720	0·723	0·726	0·729	0·731	0·733	0·735	0·737	0·739	0·741	0·742	0·744	0·745
	150·9	160·4	169·9	179·4	188·9	198·3	207·8	217·2	226·6	236·0	245·4	254·9	264·3	273·7	283·1
0·1	0·957	0·961	0·965	0·968	0·972	0·975	0·978	0·981	0·984	0·986	0·988	0·990	0·992	0·994	0·996
	202·9	215·3	227·7	240·2	252·7	265·2	277·7	290·2	302·8	315·4	328·0	340·6	353·2	365·8	378·4
0·2	1·305	1·311	1·316	1·321	1·326	1·331	1·335	1·339	1·341	1·345	1·348	1·351	1·354	1·357	1·360
	276·6	293·6	310·7	327·8	344·9	362·0	379·1	396·2	413·3	430·4	447·6	464·9	482·2	499·5	516·7
0·3	1·582	1·589	1·595	1·601	1·607	1·613	1·618	1·623	1·627	1·631	1·635	1·638	1·641	1·644	1·647
	335·4	356·0	376·6	397·3	418·0	438·7	459·3	479·9	500·6	521·3	543·0	563·7	584·4	605·1	625·9
0·4	1·819	1·827	1·835	1·842	1·849	1·855	1·861	1·866	1·871	1·876	1·880	1·884	1·888	1·892	1·895
	385·7	409·4	433·2	457·0	480·8	504·6	528·5	552·4	576·2	600·2	624·2	648·2	672·2	696·2	720·1
0·5	2·021	2·030	2·039	2·047	2·054	2·061	2·068	2·074	2·080	2·085	2·090	2·094	2·098	2·102	2·105
	428·4	454·8	481·2	507·6	534·0	560·5	587·1	613·7	640·3	667·0	693·7	720·3	746·9	773·4	799·9
0·6	2·210	2·220	2·230	2·239	2·247	2·254	2·261	2·267	2·273	2·279	2·284	2·289	2·293	2·297	2·300
	468·5	497·4	526·3	555·2	584·1	613·1	642·1	671·1	700·1	729·1	758·1	787·1	816·0	845·0	874·0
0·7	2·382	2·393	2·403	2·413	2·422	2·430	2·437	2·444	2·450	2·456	2·462	2·467	2·472	2·477	2·481
	505·0	536·2	567·4	598·6	629·8	661·0	692·2	723·4	754·7	786·0	817·8	848·6	880·0	911·4	942·8
0·8	2·541	2·553	2·564	2·574	2·583	2·592	2·600	2·607	2·614	2·621	2·627	2·632	2·637	2·642	2·646
	538·6	571·8	605·1	638·4	671·7	705·0	738·4	771·8	805·2	838·7	872·2	905·6	939·1	972·5	1006

0·9	2·690 570·3	2·703 605·4	2·715 640·5	2·725 675·7	2·734 710·9	2·743 746·1	2·752 781·4	2·760 816·8	2·767 852·2	2·774 887·6	2·780 923·0	2·786 958·5	2·791 994·2	2·796 1030	2·800 1066
1·0	2·835 601·0	2·848 638·1	2·860 675·2	2·872 712·3	2·882 749·5	2·892 786·7	2·901 823·9	2·909 861·1	2·917 898·3	2·924 935·5	2·930 972·8	2·936 1010	2·942 1047	2·947 1084	2·952 1122
1·2	3·106 658·4	3·120 699·0	3·133 739·6	3·146 780·2	3·157 820·9	3·168 861·6	3·178 902·2	3·187 942·9	3·195 983·6	3·203 1024	3·210 1065	3·217 1106	3·223 1147	3·229 1188	3·234 1229
1·4	3·355 711·2	3·370 755·1	3·384 799·0	3·398 842·9	3·410 886·8	3·422 930·7	3·433 974·7	3·443 1019	3·452 1063	3·460 1107	3·468 1151	3·475 1196	3·482 1241	3·498 1286	3·504 1331
1·6	3·586 760·2	3·603 807·2	3·619 854·2	3·633 901·2	3·647 948·3	3·660 995·4	3·670 1042	3·680 1089	3·689 1136	3·698 1183	3·706 1231	3·714 1278	3·722 1325	3·730 1372	3·737 1420
1·8	3·805 806·7	3·822 856·3	3·838 905·9	3·853 955·5	3·867 1005	3·880 1055	3·892 1105	3·903 1155	3·913 1205	3·923 1255	3·932 1305	3·941 1355	3·950 1405	3·958 1455	3·964 1506
2·0	4·010 850·2	4·028 902·7	4·045 955·2	4·062 1008	4·077 1060	4·091 1113	4·103 1165	4·115 1217	4·126 1270	4·135 1323	4·144 1376	4·153 1428	4·161 1481	4·169 1534	4·177 1587

CLASS I. ($n = 0\cdot025$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 4·5.

For Bottom-Widths of

Fall per thousand.	50	54	58	62	66	70	74	78	82	86	90	94	98	102	106
0·02	0·543	0·547	0·551	0·554	0·557	0·559	0·561	0·563	0·565	0·567	0·569	0·571	0·572	0·573	0·574
	138·6	149·4	160·3	171·2	182·1	193·0	203·9	214·8	225·7	236·6	247·6	258·5	269·4	280·3	291·2
0·03	0·627	0·632	0·637	0·641	0·644	0·647	0·649	0·651	0·653	0·655	0·657	0·659	0·661	0·663	0·665
	160·2	172·8	185·4	198·1	210·8	223·5	236·0	248·5	261·0	263·6	286·2	298·9	311·7	324·5	337·4
0·05	0·771	0·776	0·781	0·785	0·789	0·792	0·795	0·798	0·800	0·802	0·804	0·806	0·808	0·810	0·812
	196·9	212·2	227·5	242·8	258·1	273·5	288·8	304·1	319·4	334·7	350·1	365·5	381·0	396·5	412·0
0·07	0·884	0·889	0·894	0·899	0·903	0·907	0·911	0·914	0·917	0·919	0·922	0·924	0·926	0·928	0·930
	225·7	243·2	260·7	278·2	295·7	313·2	330·9	348·6	366·2	383·8	401·4	419·0	436·6	454·2	471·8
0·1	1·031	1·037	1·042	1·047	1·052	1·056	1·060	1·064	1·067	1·070	1·073	1·075	1·077	1·079	1·081
	263·3	283·5	303·8	324·1	344·4	364·7	385·1	405·5	426·0	446·5	467·0	487·4	507·8	528·1	548·4
0·2	1·402	1·410	1·418	1·425	1·431	1·437	1·443	1·448	1·452	1·456	1·460	1·463	1·466	1·469	1·471
	358·0	385·6	413·2	440·8	468·5	496·2	524·0	551·8	579·6	607·5	635·4	663·2	690·9	718·6	746·3
0·3	1·700	1·709	1·718	1·726	1·733	1·739	1·745	1·750	1·755	1·760	1·764	1·768	1·772	1·776	1·780
	434·1	467·4	500·7	534·0	567·3	600·6	634·1	667·6	700·1	734·6	768·1	801·8	835·5	869·2	903·0
0·4	1·957	1·968	1·978	1·988	1·997	2·005	2·011	2·017	2·023	2·029	2·034	2·038	2·042	2·046	2·050
	499·7	538·2	576·7	615·8	653·9	692·5	731·1	769·7	808·3	846·9	885·5	924·1	962·7	1001	1040
0·5	2·167	2·180	2·191	2·201	2·210	2·218	2·226	2·233	2·239	2·245	2·250	2·255	2·260	2·265	2·270
	553·4	595·9	638·4	680·9	723·4	765·9	808·6	851·3	894·0	936·7	979·5	1022	1065	1108	1151

0·6	2·364 603·7	2·378 650·2	2·390 696·7	2·402 743·2	2·412 789·7	2·421 836·2	2·429 882·7	2·436 929·2	2·443 975·8	2·450 1022	2·456 1069	2·462 1115	2·467 1162	2·472 1209	2·477 1256
0·7	2·549 650·9	2·563 701·0	2·576 751·1	2·589 801·2	2·600 851·3	2·610 901·4	2·618 951·7	2·626 1002	2·634 1052	2·641 1102	2·647 1153	2·653 1203	2·659 1254	2·665 1304	2·671 1355
0·8	2·725 695·8	2·740 749·3	2·754 802·8	2·767 856·4	2·779 910·0	2·790 963·6	2·800 1017	2·809 1070	2·817 1124	2·824 1178	2·831 1232	2·837 1286	2·843 1340	2·849 1394	2·854 1448
0·9	2·884 736·4	2·900 793·1	2·915 849·8	2·929 906·5	2·941 963·2	2·953 1020	2·963 1076	2·972 1133	2·981 1190	2·989 1247	2·996 1304	3·003 1361	3·009 1418	3·015 1475	3·020 1532
1·0	3·040 776·3	3·057 836·0	3·073 895·8	3·087 955·6	3·100 1015	3·112 1075	3·123 1135	3·133 1195	3·142 1255	3·150 1315	3·158 1875	3·165 1435	3·172 1495	3·179 1555	3·186 1616
1·2	3·330 850·4	3·348 915·8	3·365 981·3	3·382 1046	3·397 1112	3·410 1178	3·421 1243	3·432 1308	3·442 1374	3·451 1440	3·460 1506	3·468 1571	3·475 1637	3·482 1703	3·489 1769
1·4	3·597 918·6	3·617 989·3	3·636 1060	3·653 1130	3·668 1201	3·682 1272	3·696 1343	3·708 1414	3·718 1485	3·727 1556	3·736 1627	3·744 1698	3·752 1769	3·760 1840	3·767 1911

CLASS I. ($n = 0 \cdot 025.$)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 5·0.

For Bottom-Widths of

Fall per thousand.	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150
0·02	0·589 184·1	0·594 200·6	0·599 217·1	0·603 233·6	0·606 250·0	0·609 266·4	0·612 282·9	0·614 299·4	0·616 315·9	0·618 332·3	0·620 348·7	0·622 365·2	0·623 381·7	0·625 398·2	0·626 414·6	0·627 431·0	0·628 447·5	0·629 464·0	0·630 480·5	0·631 496·9
0·03	0·679 212·2	0·685 231·1	0·691 250·0	0·695 269·0	0·699 288·0	0·702 307·0	0·705 325·9	0·708 344·8	0·710 363·8	0·712 382·8	0·714 401·8	0·716 420·8	0·718 439·8	0·720 458·8	0·722 477·9	0·723 497·0	0·725 516·0	0·726 535·1	0·727 554·2	0·728 573·3
0·05	0·829 259·0	0·837 282·0	0·843 305·0	0·847 328·0	0·851 351·0	0·855 374·1	0·859 397·2	0·862 420·3	0·865 443·4	0·868 466·6	0·871 489·8	0·874 512·9	0·876 536·0	0·878 559·2	0·880 582·4	0·881 605·6	0·883 628·8	0·885 652·0	0·886 675·3	0·887 698·6
0·07	0·950 296·6	0·956 322·7	0·962 348·8	0·967 374·9	0·972 401·0	0·976 427·2	0·980 453·3	0·984 479·4	0·987 505·6	0·990 531·8	0·993 558·0	0·995 584·1	0·997 610·2	0·999 636·4	1·000 662·6	1·002 688·8	1·004 715·0	1·006 741·2	1·007 767·5	1·008 793·8
0·1	1·104 344·4	1·112 374·8	1·119 405·2	1·125 435·6	1·130 466·0	1·135 496·5	1·139 526·9	1·143 557·3	1·147 587·7	1·150 618·1	1·153 648·6	1·156 679·0	1·159 709·5	1·161 740·0	1·163 770·5	1·165 801·0	1·167 831·6	1·169 862·2	1·171 892·8	1·173 923·5
0·2	1·502 469·2	1·512 510·2	1·521 551·2	1·528 592·2	1·535 633·2	1·541 674·3	1·547 715·6	1·552 756·9	1·557 798·2	1·562 839·5	1·566 880·7	1·569 921·9	1·572 963·1	1·575 1004	1·578 1045	1·581 1087	1·584 1128	1·586 1169	1·588 1210	1·590 1252
0·3	1·814 566·9	1·826 616·5	1·837 666·1	1·846 715·7	1·855 765·4	1·863 815·1	1·870 864·8	1·876 914·6	1·881 964·4	1·886 1014	1·891 1064	1·895 1113	1·899 1163	1·903 1213	1·907 1263	1·910 1313	1·913 1363	1·916 1413	1·919 1463	1·922 1513
0·4	2·091 653·4	2·104 710·5	2·116 767·6	2·127 824·7	2·137 881·8	2·146 938·9	2·155 996·1	2·162 1053	2·168 1110	2·174 1167	2·179 1225	2·184 1282	2·189 1339	2·193 1397	2·197 1455	2·201 1513	2·204 1570	2·207 1627	2·210 1685	2·213 1743
0·5	2·314 723·1	2·329 786·2	2·343 849·4	2·355 912·6	2·366 975·8	2·376 1039	2·385 1102	2·393 1165	2·401 1228	2·407 1292	2·413 1356	2·418 1419	2·423 1483	2·428 1547	2·433 1611	2·437 1675	2·441 1738	2·445 1801	2·448 1865	2·451 1930

0·6	2·525	2·541	2·556	2·570	2·582	2·593	2·602	2·611	2·619	2·626
	789·1	858·0	927·0	996·0	1065	1134	1203	1272	1341	1410
0·7	2·721	2·740	2·756	2·770	2·783	2·795	2·806	2·815	2·823	2·830
	850·4	924·9	999·4	1074	1148	1223	1297	1371	1446	1521
0·8	2·909	2·929	2·946	2·961	2·974	2·986	2·997	3·007	3·015	3·021
	909·1	988·5	1068	1147	1226	1306	1385	1464	1543	1623
0·9	3·080	3·100	2·118	3·135	3·149	3·161	3·172	3·182	3·191	3·199
	962·4	1046	1130	1214	1298	1383	1467	1551	1635	1719
1·0	3·247	3·269	3·288	3·304	3·318	3·331	3·343	3·353	3·362	3·371
	1015	1103	1191	1279	1368	1457	1545	1633	1722	1811
1·2	3·556	3·580	3·601	3·620	3·636	3·650	3·662	3·673	3·683	3·693
	1111	1208	1305	1402	1499	1597	1694	1791	1888	1985
1·4	3·842	3·867	3·889	3·909	3·927	3·943	3·956	3·968	3·979	3·989
	1200	1305	1410	1515	1620	1725	1830	1935	2040	2145

0·6	2·632	2·638	2·644	2·649	2·654	2·659	2·663	2·667	2·671	2·675
	1480	1549	1618	1688	1758	1828	1897	1967	2037	2107
0·7	2·837	2·844	2·851	2·857	2·862	2·867	2·871	2·875	2·879	2·883
	1596	1671	1746	1821	1896	1971	2046	2121	2196	2271
0·8	3·028	3·035	3·042	3·047	3·052	3·056	3·061	3·065	3·069	3·073
	1703	1782	1861	1941	2021	2101	2180	2260	2340	2420
0·9	3·206	3·213	3·219	3·225	3·231	3·236	3·241	3·246	3·250	3·254
	1804	1888	1972	2056	2140	2225	2309	2393	2478	2563
1·0	3·379	3·386	3·393	3·399	3·405	3·411	3·416	3·421	3·425	3·429
	1900	1989	2078	2167	2256	2345	2434	2523	2612	2700
1·2	3·702	3·710	3·717	3·724	3·731	3·737	3·742	3·747	3·752	3·757
	2083	2180	2277	2374	2471	2569	2666	2763	2861	2959
1·4	3·998	4·007	4·015	4·023	4·030	4·037	4·043	4·048	4·052	4·056
	2250	2355	2460	2565	2670	2775	2881	2987	3093	3200

CLASS I. ($n = 0·025$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 5·5.

For Bottom-Widths of

Fall per thousand.	60	66	72	78	84	90	96	102	108	114	120	126	132
0·02	0·632 237·2	0·637 260·4	0·642 283·6	0·647 306·9	0·651 330·2	0·654 353·5	0·657 376·8	0·660 400·2	0·663 423·6	0·665 447·0	0·667 470·4	0·669 493·8	0·670 517·2
0·03	0·728 273·3	0·735 300·1	0·741 326·9	0·746 353·7	0·750 380·6	0·754 407·5	0·758 434·3	0·761 461·1	0·764 488·0	0·766 514·9	0·768 541·8	0·770 568·6	0·772 595·5
0·05	0·888 333·3	0·896 366·0	0·903 398·7	0·909 431·4	0·914 464·1	0·919 496·8	0·923 529·5	0·927 562·2	0·930 594·9	0·933 627·6	0·936 660·3	0·939 693·1	0·941 725·9
0·07	1·009 378·5	1·016 415·2	1·023 451·9	1·030 488·6	1·035 525·4	1·040 562·2	1·045 599·1	1·049 636·0	1·053 673·0	1·056 710·0	1·059 747·0	1·062 784·1	1·064 821·2
0·1	1·174 440·7	1·183 483·3	1·191 525·9	1·198 568·5	1·204 611·2	1·210 653·9	1·216 696·8	1·221 739·7	1·225 782·6	1·228 825·5	1·231 868·4	1·234 911·3	1·237 954·2
0·2	1·591 597·8	1·603 654·9	1·614 712·5	1·623 770·2	1·632 827·9	1·639 885·6	1·645 943·2	1·651 1000	1·656 1050	1·661 1116	1·665 1174	1·669 1232	1·673 1290
0·3	1·923 721·8	1·937 791·4	1·950 861·0	1·961 930·6	1·971 1000	1·980 1070	1·988 1140	1·995 1210	2·001 1280	2·007 1350	2·012 1419	2·017 1489	2·022 1559
0·4	2·213 830·6	2·229 910·2	2·243 989·9	2·255 1070	2·265 1150	2·275 1229	2·284 1309	2·291 1389	2·298 1469	2·304 1549	2·309 1628	2·314 1708	2·319 1788
0·5	2·453 920·9	2·471 1009	2·487 1097	2·501 1185	2·513 1274	2·523 1363	2·532 1451	2·540 1539	2·548 1628	2·555 1717	2·561 1806	2·567 1895	2·573 1984

0·6	2·677 1005	2·696 1101	2·713 1197	2·728 1293	2·741 1390	2·753 1487	2·764 1583	2·773 1680	2·781 1777	2·788 1874	2·795 1971	2·801 2068	2·807 2165
0·7	2·882 1082	2·902 1185	2·920 1289	2·936 1393	2·950 1497	2·962 1601	2·973 1705	2·983 1809	2·992 1913	3·000 2017	3·007 2121	3·014 2225	3·020 2329
0·8	3·075 1154	3·097 1264	3·116 1375	3·133 1486	3·148 1597	3·161 1708	3·172 1819	3·182 1930	3·191 2041	3·200 2152	3·208 2263	3·216 2374	3·223 2485
0·9	3·255 1222	3·277 1349	3·297 1466	3·315 1583	3·331 1700	3·345 1808	3·357 1925	3·368 2042	3·379 2160	3·389 2278	3·397 2396	3·404 2513	3·411 2631
1·0	3·432 1288	3·456 1411	3·477 1534	3·495 1657	3·511 1781	3·526 1905	3·539 2029	3·551 2153	3·562 2277	3·572 2401	3·581 2526	3·589 2650	3·596 2774
1·2	3·759 1411	3·785 1546	3·808 1681	3·828 1816	3·846 1951	3·862 2087	3·877 2222	3·890 2358	3·902 2494	3·913 2630	3·922 2766	3·931 2902	3·939 3038
1·4	4·060 1524	4·088 1670	4·113 1816	4·135 1962	4·155 2108	4·173 2255	4·188 2401	4·202 2547	4·215 2694	4·226 2841	4·236 2998	4·246 3135	4·255 3282

CLASS I. (n = 0·025.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 5·5.

For Bottom-Widths of

Fall per thousand.	138	144	150	156	162	168	174	180	186	192	198	204
0·02	0·672 540·6	0·674 564·0	0·675 587·5	2·677 610·8	0·678 634·1	0·679 657·4	0·680 680·8	0·681 704·2	0·681 727·8	0·682 751·4	0·683 775·0	0·684 798·6
0·03	0·774 622·4	0·776 649·3	0·777 676·2	0·779 703·1	0·780 730·0	0·781 756·9	0·782 783·8	0·783 810·7	0·784 837·4	0·785 864·1	0·785 890·8	0·786 917·5
0·05	0·943 758·7	0·945 791·5	0·947 824·3	0·949 857·2	0·951 890·1	0·952 923·0	0·954 956·0	0·955 989·0	0·956 1021	0·957 1054	0·958 1087	0·959 1120
0·07	1·067 858·2	1·069 895·2	1·071 932·2	1·073 969·2	1·074 1006	1·075 1043	1·077 1080	1·079 1117	1·080 1154	1·081 1191	1·082 1228	1·083 1264
0·1	1·240 997·1	1·242 1040	1·244 1083	1·246 1126	1·248 1169	1·250 1212	1·252 1255	1·253 1297	1·254 1340	1·256 1383	1·257 1426	1·258 1468
0·2	1·677 1348	1·680 1406	1·683 1465	1·686 1523	1·688 1581	1·690 1639	1·692 1697	1·694 1754	1·696 1812	1·698 1870	1·700 1928	1·702 1987
0·3	2·026 1629	2·030 1699	2·033 1769	2·037 1839	2·040 1909	2·043 1979	2·046 2050	2·048 2121	2·050 2191	2·052 2261	2·054 2331	2·056 2401
0·4	2·323 1868	2·327 1948	2·331 2028	2·335 2108	2·338 2188	2·341 2268	2·344 2349	2·347 2430	2·350 2510	2·352 2590	2·354 2670	2·356 2750
0·5	2·578 2073	2·583 2162	2·587 2252	2·591 2341	2·594 2430	2·597 2519	2·601 2608	2·604 2696	2·607 2784	2·610 2872	2·612 2961	2·614 3051

0·6	2·812 2262	2·817 2359	2·822 2456	2·826 2553	2·830 2650	2·834 2747	2·838 2844	2·841 2942	2·844 3039	2·847 3136	2·850 3233	2·852 3330
0·7	3·026 2433	3·032 2538	3·037 2643	3·042 2747	3·046 2851	3·050 2956	3·054 3061	3·057 3166	3·060 3270	3·063 3374	3·066 3478	3·069 3582
0·8	3·229 2596	3·235 2708	3·240 2820	3·245 2931	3·249 3042	3·253 3153	3·257 3265	3·261 3377	3·265 3488	3·268 3599	3·271 3710	3·274 3822
0·9	3·417 2749	3·423 2867	3·429 2985	3·434 3103	3·439 3221	3·444 3339	3·448 3457	3·452 3575	3·456 3693	3·460 3811	3·464 3929	3·467 4047
1·0	3·603 2898	3·609 3022	3·615 3147	3·621 3271	3·626 3395	3·631 3519	3·635 3644	3·639 3769	3·643 3893	3·647 4017	3·651 4142	3·655 4267
1·2	3·946 3174	3·953 3310	3·960 3447	3·966 3583	3·972 3719	3·977 3855	3·982 3991	3·986 4128	3·990 4264	3·994 4400	3·998 4536	4·002 4672
1·4	4·263 3429	4·271 3576	4·278 3723	4·284 3870	4·290 4017	4·295 4164	4·300 4311	4·305 4459	4·310 4606	4·314 4753	4·318 4900	4·322 5046

CLASS I. ($n = 0\cdot025$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 6·0.

For Bottom-Widths of

Fall per thousand.	67	74	81	88	95	102	109	116	123	130	137	144	151	158	165
0·02	0·677 308·7	0·684 340·4	0·690 372·1	0·694 403·9	0·698 435·7	0·702 467·5	0·705 499·4	0·708 531·3	0·711 563·2	0·714 595·2	0·716 627·2	0·718 659·2	0·719 691·2	0·721 723·2	0·723 755·2
0·03	0·781 356·1	0·786 392·1	0·791 428·1	0·796 464·1	0·801 500·1	0·805 536·2	0·809 572·6	0·812 609·0	0·815 645·4	0·817 681·8	0·820 718·2	0·822 754·6	0·824 791·0	0·826 827·4	0·828 863·8
0·05	0·950 433·7	0·958 477·6	0·965 521·5	0·971 565·4	0·976 609·3	0·981 653·2	0·985 697·0	0·989 740·8	0·992 784·7	0·994 828·6	0·996 872·5	0·999 916·4	1·001 960·3	1·003 1004	1·005 1048
0·07	1·073 489·3	1·082 539·0	1·090 588·7	1·097 638·4	1·103 688·1	1·108 737·9	1·112 787·7	1·116 837·5	1·120 887·4	1·124 937·3	1·127 987·2	1·130 1037	1·133 1087	1·135 1137	1·137 1187
0·1	1·247 568·6	1·257 626·0	1·266 683·4	1·273 740·9	1·279 798·4	1·285 855·9	1·290 913·5	1·295 971·1	1·299 1029	1·303 1086	1·306 1144	1·309 1201	1·312 1258	1·315 1316	1·317 1374
0·2	1·686 768·8	1·700 846·4	1·712 924·0	1·722 1002	1·730 1079	1·738 1157	1·745 1234	1·751 1312	1·756 1390	1·761 1468	1·765 1546	1·769 1623	1·773 1701	1·776 1779	1·779 1857
0·3	2·039 929·8	2·054 1023	2·067 1116	2·078 1209	2·087 1302	2·096 1396	2·105 1489	2·112 1583	2·118 1677	2·124 1771	2·129 1865	2·134 1958	2·139 2052	2·143 2146	2·146 2240
0·4	2·337 1065	2·354 1172	2·369 1279	2·382 1386	2·393 1493	2·403 1600	2·413 1707	2·421 1814	2·428 1921	2·434 2029	2·440 2137	2·445 2244	2·450 2351	2·455 2459	2·459 2567
0·5	2·591 1181	2·610 1300	2·627 1419	2·643 1538	2·656 1657	2·667 1776	2·676 1895	2·684 2014	2·692 2133	2·700 2252	2·707 2371	2·713 2490	2·718 2609	2·723 2728	2·728 2847

0·6	2·830 1290	2·850 1419	2·868 1548	2·883 1677	2·897 1807	2·909 1937	2·920 2067	2·930 2197	2·939 2327	2·946 2457	2·953 2587	2·960 2717	2·966 2847	2·971 2977	2·976 3107
0·7	3·044 1388	3·066 1527	3·086 1666	3·103 1805	3·118 1945	3·131 2085	3·141 2224	3·151 2364	3·161 2504	3·170 2644	3·178 2784	3·185 2924	3·191 3064	3·197 3204	3·203 3344
0·8	3·248 1481	3·271 1629	3·292 1777	3·310 1926	3·326 2075	3·340 2224	3·352 2373	3·363 2522	3·373 2671	3·382 2820	3·390 2970	3·398 3119	3·405 3268	3·411 3417	3·417 3567
0·9	3·437 1567	3·462 1724	3·484 1881	3·504 2039	3·521 2197	3·536 2355	3·548 2512	3·559 2670	3·570 2828	3·580 2986	3·589 3144	3·597 3302	3·604 3460	3·611 3618	3·617 3776
1·0	3·623 1652	3·648 1817	3·671 1983	3·692 2149	3·710 2315	3·726 2481	3·740 2647	3·753 2813	3·764 2980	3·774 3147	3·783 3314	3·791 3480	3·799 3647	3·806 3814	3·813 3981
1·2	3·967 1809	3·997 1991	4·023 2173	4·045 2355	4·065 2537	4·083 2719	4·097 2901	4·110 3083	4·122 3265	4·134 3447	4·144 3630	4·153 3812	4·162 3994	4·170 4177	4·177 4360
1·4	4·288 1955	4·318 2151	4·345 2347	4·369 2543	4·391 2740	4·410 2937	4·426 3133	4·440 3330	4·453 3527	4·465 3724	4·476 3921	4·486 4118	4·496 4315	4·504 4512	4·512 4710

CLASS I. (n = 0·025.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 6·0.

For Bottom-Widths of

Fall per thousand.	172	179	186	193	200	207	214	221	228	235	242	249	256	263	270
0·02	0·725 787·3	0·727 819·3	0·728 851·3	0·729 883·3	0·730 915·3	0·731 947·3	0·732 979·2	0·733 1011	0·734 1043	0·734 1075	0·735 1107	0·736 1139	0·736 1171	0·737 1203	0·738 1235
0·03	0·829 900·3	0·831 936·8	0·832 973·3	0·833 1010	0·834 1046	0·835 1083	0·836 1119	0·837 1155	0·838 1191	0·839 1228	0·840 1265	0·841 1301	0·841 1337	0·842 1374	0·843 1411
0·05	1·006 1092	1·008 1136	1·009 1184	1·010 1224	1·012 1268	1·013 1312	1·014 1356	1·015 1400	1·016 1444	1·017 1488	1·018 1533	1·019 1577	1·019 1621	1·020 1665	1·021 1709
0·07	1·139 1237	1·141 1287	1·143 1337	1·144 1387	1·146 1437	1·148 1487	1·149 1537	1·151 1587	1·152 1637	1·153 1687	1·154 1738	1·155 1788	1·156 1838	1·157 1888	1·158 1938
0·1	1·319 1432	1·321 1490	1·323 1548	1·325 1606	1·327 1664	1·329 1722	1·330 1779	1·332 1837	1·333 1895	1·334 1953	1·335 2011	1·336 2068	1·337 2125	1·338 2183	1·339 2241
0·2	1·782 1935	1·785 2012	1·787 2090	1·789 2168	1·791 2246	1·793 2324	1·795 2402	1·797 2480	1·799 2558	1·800 2636	1·802 2714	1·803 2792	1·804 2870	1·805 2947	1·806 3024
0·3	2·149 2334	2·152 2428	2·155 2522	2·157 2616	2·160 2709	2·162 2802	2·164 2896	2·166 2990	2·168 3084	2·169 3177	2·171 3270	2·173 3364	2·175 3458	2·176 3551	2·177 3644
0·4	2·463 2675	2·467 2782	2·471 2890	2·474 2998	2·477 3106	2·480 3214	2·482 3322	2·485 3430	2·487 3538	2·489 3646	2·491 3752	2·493 3861	2·495 3969	2·497 4076	2·499 4183
0·5	2·733 2967	2·737 3086	2·740 3205	2·743 3324	2·746 3444	2·749 3564	2·752 3683	2·755 3702	2·758 3822	2·761 3942	2·764 4162	2·766 4282	2·768 4402	2·770 4521	2·772 4640

0·6	2·981 3237	2·986 3367	2·990 3497	2·994 3627	2·998 3758	3·001 3889	3·004 4020	3·007 4151	3·010 4281	3·013 4411	3·016 4541	3·018 4672	3·020 4802	3·022 4932	3·024 5062
0·7	3·208 3484	3·213 3625	3·217 3765	3·221 3905	3·225 4045	3·229 4185	3·232 4325	3·235 4465	8·238 4605	3·241 4745	3·244 4885	3·247 5025	2·249 5165	3·251 5305	3·253 5445
0·8	3·423 3717	3·428 3866	3·433 4015	3·437 4165	3·441 4315	3·445 4465	3·449 4614	3·453 4763	3·456 4913	3·459 5063	3·462 5213	3·465 5362	3·467 5512	3·470 5662	3·472 5812
0·9	3·623 3934	3·628 4092	3·633 4250	3·638 4408	3·643 4567	3·647 4726	3·651 4884	3·654 5042	3·657 5200	3·660 5359	3·664 5518	3·667 5676	3·670 5835	3·673 5994	3·676 6153
1·0	3·820 4148	3·825 4315	3·830 4482	3·835 4649	3·840 4816	3·845 4983	3·849 5150	8·853 5317	3·856 5484	3·859 5651	3·862 5817	3·865 5984	3·868 6151	3·871 6318	3·874 6485
1·2	4·184 4543	4·190 4725	4·195 4908	4·200 5091	4·205 5274	4·210 5457	4·215 5640	4·220 5823	4·224 6006	4·228 6189	4·232 6373	4·235 6556	4·238 6739	4·241 6922	4·244 7104
1·4	4·519 4908	4·525 5105	4·531 5302	4·537 5499	4·543 5697	4·548 5895	4·553 6092	4·558 6289	4·562 6486	4·566 6604	4·570 6882	4·574 7079	4·577 7276	4·580 7474	4·583 7672

SECOND CLASS.

RIVERS AND CANALS,

WITH BEDS AND BANKS IN MODERATELY GOOD ORDER IN EVERY RESPECT.

$n = 0 \cdot 030.$

CLASS II. ($n = 0 \cdot 030$.)

Coefficients of Mean Velocity.

For Values of R.

Fall per thousand.	0·1	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9
0·05	—	—	—	—	26·5	28·1	29·6	31·0	32·2
0·07	—	—	—	—	27·0	28·5	29·9	31·2	32·3
0·1	15·5	20·0	23·0	25·2	27·3	28·9	30·3	31·4	32·4
0·2	16·5	21·0	23·8	26·0	27·8	29·2	30·4	31·4	32·4
0·3	17·0	21·3	24·2	26·3	28·2	29·4	30·5	31·5	32·5
0·4	17·2	21·5	24·3	26·4	28·2	29·4	30·5	31·5	32·5
0·5	17·3	21·6	24·3	26·5	28·2	29·4	30·6	31·6	32·5
0·6	17·4	21·7	24·4	26·5	28·3	29·5	30·7	31·6	32·5
0·7	17·5	21·8	24·5	26·6	28·3	29·5	30·7	31·6	32·5
0·8	17·6	21·9	24·6	26·6	28·4	29·6	30·8	31·7	32·5
0·9	17·7	22·0	24·7	26·7	28·4	29·6	30·8	31·7	32·5
1·0	17·7	22·0	24·7	26·7	28·4	29·6	30·8	31·7	32·5

For Values of R.

Fall per thousand.	2·6	2·8	3·0	3·2	3·4	3·6	3·8	4·0	4·2
0·02	—	—	—	—	—	51·8	52·7	53·5	54·3
0·03	—	—	—	—	—	49·6	50·3	51·0	51·7
0·05	43·5	44·3	45·0	45·7	46·4	47·0	47·6	48·1	48·6
0·07	42·6	43·3	44·0	44·7	45·2	45·8	46·2	46·7	47·2
0·1	41·7	42·4	43·0	43·5	44·0	44·5	45·0	45·4	45·8
0·2	40·6	41·1	41·6	42·1	42·5	43·0	43·3	43·7	44·0
0·3	40·2	40·7	41·2	41·6	42·0	42·4	42·8	43·1	43·4
0·4	40·0	40·5	41·0	41·4	41·7	42·2	42·5	42·8	43·1
0·5	39·9	40·3	40·8	41·1	41·5	41·9	42·2	42·5	42·8
0·6	39·7	40·2	40·6	41·0	41·4	41·8	41·9	42·2	42·5
0·7	39·7	40·1	40·5	40·9	41·3	41·6	41·8	42·1	42·4
0·8	39·7	40·1	40·4	40·8	41·2	41·5	41·8	42·1	42·4
0·9	39·7	40·1	40·3	40·7	41·1	41·4	41·7	42·0	42·3
1·0	39·7	40·1	40·3	40·7	41·1	41·4	41·7	42·0	42·3

The coefficients remain unaltered for steeper inclinations.

CLASS II. ($n = 0\cdot030$.)

Coefficients of Mean Velocity.

For Values of R.

1·0	1·2	1·4	1·6	1·8	2·0	2·2	2·4	Fall per thousand.
33·3	35·3	36·9	38·2	39·4	40·5	41·6	42·6	0·05
33·3	35·2	36·6	37·8	38·9	39·9	40·9	41·8	0·07
33·3	35·0	36·3	37·4	38·5	39·4	40·2	41·0	0·1
33·3	34·8	36·0	37·0	37·9	38·7	39·4	40·0	0·2
33·3	34·7	35·8	36·7	37·6	38·4	39·1	39·7	0·3
33·3	34·7	35·8	36·7	37·5	38·3	39·0	39·5	0·4
33·3	34·7	35·7	36·6	37·4	38·1	38·8	39·4	0·5
33·3	34·7	35·7	36·6	37·4	38·1	38·7	39·2	0·6
33·3	34·7	35·7	36·6	37·4	38·1	38·7	39·2	0·7
33·3	34·7	35·7	36·6	37·4	38·1	38·7	39·2	0·8
33·3	34·7	35·7	36·6	37·4	38·1	38·7	39·2	0·9
33·3	34·7	35·7	36·6	37·4	38·1	38·7	39·2	1·0

For Values of R.

4·4	4·6	4·8	5·0	5·2	5·4	5·6	5·8	6·0	Fall per thousand.
55·1	55·8	56·5	57·2	57·8	58·4	59·0	59·5	60·0	0·02
52·3	52·9	53·5	54·1	54·7	55·2	55·6	56·0	56·4	0·03
49·1	49·6	50·1	50·6	51·1	51·6	52·1	52·4	52·5	0·05
47·6	48·0	48·4	48·8	49·2	49·6	49·9	50·2	50·5	0·07
46·2	46·6	46·9	47·2	47·5	47·8	48·1	48·4	48·6	0·1
44·3	44·6	44·9	45·2	45·5	45·8	46·0	46·2	46·4	0·2
43·7	40·0	44·3	44·5	44·7	44·9	45·1	45·3	45·5	0·3
43·4	43·8	44·0	44·2	44·4	44·6	44·8	45·0	45·2	0·4
43·1	43·4	43·7	43·9	44·1	44·3	44·5	44·7	44·9	0·5
42·8	43·1	43·4	43·6	43·8	44·0	44·2	44·4	44·6	0·6
42·7	43·0	43·2	43·4	43·6	43·8	44·0	44·2	44·4	0·7
42·7	42·9	43·1	43·3	43·5	43·7	43·9	44·1	44·3	0·8
42·6	42·8	43·0	43·2	43·4	43·6	43·8	44·0	44·2	0·9
42·6	42·8	43·0	43·2	43·4	43·6	43·8	44·0	44·2	1·0

The coefficients remain unaltered for steeper inclinations.

CLASS II. (n = 0·030.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 0·2.

For Bottom-Widths of

Fall per thousand.	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9	1·0	1·2	1·4	1·6	1·8	2·0	2·5
0·1	0·053	0·056	0·059	0·061	0·063	0·065	0·067	0·069	0·070	0·072	0·074	0·075	0·077	0·078	0·079
	0·005	0·006	0·007	0·009	0·011	0·013	0·014	0·016	0·018	0·021	0·025	0·029	0·034	0·039	0·044
0·2	0·079	0·084	0·088	0·092	0·095	0·097	0·099	0·101	0·103	0·106	0·109	0·112	0·114	0·116	0·117
	0·008	0·010	0·012	0·014	0·016	0·019	0·021	0·024	0·027	0·032	0·037	0·043	0·050	0·058	0·066
0·3	0·100	0·106	0·111	0·115	0·119	0·122	0·125	0·127	0·129	0·133	0·136	0·139	0·142	0·145	0·147
	0·010	0·012	0·015	0·018	0·021	0·024	0·027	0·030	0·034	0·039	0·045	0·053	0·062	0·072	0·082
0·4	0·116	0·123	0·129	0·134	0·138	0·142	0·145	0·148	0·150	0·154	0·158	0·162	0·165	0·168	0·171
	0·012	0·015	0·018	0·021	0·024	0·028	0·031	0·035	0·039	0·046	0·054	0·062	0·072	0·084	0·096
0·5	0·131	0·138	0·144	0·150	0·155	0·160	0·163	0·166	0·169	0·174	0·178	0·182	0·186	0·189	0·192
	0·013	0·016	0·020	0·024	0·028	0·032	0·036	0·040	0·044	0·051	0·059	0·069	0·080	0·093	0·108
0·6	0·144	0·152	0·159	0·166	0·171	0·176	0·180	0·183	0·186	0·191	0·196	0·200	0·204	0·208	0·212
	0·014	0·018	0·022	0·026	0·030	0·035	0·039	0·043	0·048	0·056	0·066	0·076	0·088	0·102	0·119
0·7	0·156	0·165	0·173	0·180	0·185	0·190	0·194	0·198	0·201	0·207	0·212	0·217	0·222	0·226	0·230
	0·016	0·020	0·024	0·028	0·033	0·038	0·042	0·047	0·052	0·060	0·070	0·082	0·095	0·111	0·129
0·8	0·168	0·177	0·186	0·193	0·200	0·205	0·209	0·213	0·216	0·222	0·228	0·234	0·239	0·243	0·247
	0·017	0·021	0·026	0·031	0·036	0·041	0·046	0·051	0·056	0·065	0·076	0·089	0·103	0·119	0·138
0·9	0·179	0·189	0·198	0·206	0·212	0·218	0·223	0·227	0·231	0·237	0·243	0·249	0·254	0·259	0·263
	0·018	0·023	0·028	0·033	0·038	0·044	0·049	0·054	0·060	0·070	0·082	0·095	0·110	0·127	0·147

1·0	0·189 0·019	0·199 0·024	0·208 0·029	0·217 0·034	0·224 0·040	0·230 0·046	0·235 0·051	0·239 0·057	0·243 0·063	0·250 0·074	0·257 0·086	0·263 0·100	0·268 0·116	0·273 0·134	0·277 0·155
1·2	0·207 0·021	0·218 0·026	0·228 0·032	0·238 0·038	0·245 0·044	0·252 0·050	0·257 0·056	0·262 0·062	0·267 0·069	0·274 0·080	0·281 0·093	0·288 0·109	0·293 0·127	0·298 0·147	0·303 0·170
1·4	0·223 0·022	0·235 0·028	0·246 0·034	0·257 0·041	0·267 0·048	0·276 0·055	0·280 0·061	0·284 0·068	0·288 0·075	0·296 0·087	0·304 0·102	0·311 0·118	0·317 0·137	0·323 0·159	0·328 0·184
1·6	0·239 0·024	0·252 0·030	0·264 0·037	0·275 0·044	0·283 0·051	0·291 0·058	0·297 0·065	0·303 0·072	0·308 0·080	0·316 0·093	0·324 0·108	0·332 0·126	0·338 0·146	0·344 0·170	0·350 0·196
1·8	0·254 0·025	0·267 0·032	0·280 0·039	0·292 0·046	0·301 0·054	0·309 0·062	0·315 0·069	0·321 0·077	0·326 0·085	0·335 0·100	0·344 0·116	0·352 0·134	0·359 0·155	0·366 0·180	0·372 0·208
2·0	0·267 0·027	0·282 0·034	0·296 0·041	0·308 0·049	0·317 0·057	0·326 0·065	0·332 0·073	0·338 0·081	0·344 0·090	0·353 0·105	0·362 0·122	0·371 0·141	0·378 0·163	0·385 0·190	0·392 0·220
2·2	0·280 0·028	0·296 0·036	0·311 0·044	0·323 0·052	0·333 0·060	0·342 0·068	0·349 0·076	0·355 0·085	0·361 0·094	0·371 0·109	0·380 0·127	0·389 0·148	0·397 0·172	0·404 0·199	0·411 0·230
2·4	0·293 0·029	0·309 0·037	0·324 0·045	0·337 0·053	0·347 0·062	0·357 0·071	0·365 0·080	0·372 0·089	0·377 0·098	0·387 0·114	0·397 0·133	0·407 0·155	0·415 0·180	0·422 0·208	0·429 0·240
2·6	0·305 0·030	0·323 0·038	0·338 0·047	0·351 0·056	0·362 0·065	0·371 0·074	0·378 0·083	0·385 0·092	0·392 0·102	0·403 0·118	0·413 0·137	0·423 0·160	0·432 0·186	0·440 0·216	0·447 0·250
2·8	0·316 0·032	0·334 0·041	0·350 0·050	0·364 0·059	0·375 0·068	0·385 0·077	0·393 0·086	0·400 0·096	0·407 0·106	0·418 0·123	0·429 0·143	0·439 0·167	0·448 0·193	0·456 0·224	0·463 0·259
3·0	0·327 0·033	0·347 0·042	0·364 0·051	0·377 0·060	0·388 0·070	0·399 0·080	0·407 0·089	0·414 0·099	0·421 0·109	0·433 0·127	0·444 0·148	0·455 0·173	0·464 0·201	0·472 0·233	0·480 0·269

CLASS II. ($n = 0 \cdot 030$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 0·4.

For Bottom-Widths of

Fall per thousand.	0·4	0·6	0·8	1·0	1·2	1·4	1·6	1·8	2·0	2·5	3·0	3·5	4·0	4·5	5·0
0·1	0·096 0·038	0·102 0·049	0·107 0·060	0·111 0·071	0·115 0·083	0·119 0·095	0·122 0·107	0·124 0·119	0·126 0·131	0·130 0·162	0·134 0·193	0·137 0·224	0·139 0·255	0·141 0·286	0·142 0·318
0·2	0·142 0·057	0·150 0·073	0·158 0·089	0·164 0·106	0·170 0·123	0·175 0·140	0·179 0·157	0·182 0·174	0·185 0·192	0·191 0·237	0·196 0·282	0·200 0·327	0·203 0·373	0·206 0·419	0·208 0·466
0·3	0·177 0·071	0·187 0·091	0·197 0·111	0·204 0·132	0·211 0·153	0·217 0·174	0·222 0·195	0·226 0·217	0·230 0·239	0·237 0·294	0·243 0·350	0·247 0·406	0·251 0·462	0·254 0·519	0·257 0·576
0·4	0·206 0·082	0·218 0·106	0·229 0·130	0·238 0·154	0·246 0·178	0·252 0·202	0·258 0·227	0·263 0·252	0·267 0·278	0·275 0·342	0·282 0·406	0·287 0·470	0·291 0·535	0·295 0·601	0·298 0·667
0·5	0·227 0·091	0·246 0·118	0·257 0·145	0·266 0·172	0·274 0·199	0·281 0·226	0·288 0·254	0·294 0·282	0·299 0·311	0·308 0·383	0·316 0·455	0·322 0·528	0·327 0·602	0·331 0·676	0·335 0·750
0·6	0·253 0·101	0·270 0·130	0·282 0·159	0·292 0·188	0·302 0·218	0·310 0·248	0·317 0·278	0·322 0·309	0·327 0·340	0·337 0·420	0·347 0·500	0·354 0·580	0·359 0·660	0·363 0·741	0·367 0·822
0·7	0·275 0·110	0·291 0·141	0·306 0·173	0·317 0·205	0·327 0·237	0·336 0·269	0·344 0·302	0·350 0·336	0·356 0·370	0·366 0·456	0·376 0·542	0·384 0·629	0·389 0·716	0·394 0·804	0·398 0·892
0·8	0·294 0·118	0·311 0·151	0·327 0·185	0·339 0·219	0·350 0·253	0·359 0·288	0·368 0·323	0·375 0·359	0·381 0·396	0·392 0·488	0·402 0·580	0·410 0·674	0·418 0·768	0·423 0·862	0·427 0·957
0·9	0·311 0·124	0·329 0·160	0·346 0·196	0·359 0·232	0·371 0·268	0·381 0·305	0·390 0·348	0·397 0·381	0·404 0·420	0·416 0·517	0·427 0·615	0·435 0·714	0·442 0·818	0·449 0·916	0·455 1·019

1·0	0·328 0·131	0·347 0·169	0·365 0·207	0·378 0·245	0·391 0·283	0·401 0·321	0·411 0·361	0·419 0·402	0·426 0·443	0·438 0·545	0·450 0·648	0·459 0·752	0·466 0·857	0·473 0·965	0·479 1·073
1·2	0·359 0·144	0·380 0·185	0·400 0·226	0·415 0·268	0·429 0·310	0·440 0·352	0·451 0·396	0·459 0·440	0·466 0·485	0·480 0·597	0·493 0·710	0·503 0·825	0·511 0·940	0·518 1·058	0·525 1·176
1·4	0·389 0·156	0·412 0·200	0·432 0·245	0·448 0·290	0·464 0·335	0·476 0·381	0·487 0·428	0·496 0·476	0·504 0·524	0·518 0·644	0·532 0·766	0·543 0·890	0·552 1·016	0·560 1·142	0·567 1·270
1·6	0·415 0·166	0·439 0·213	0·462 0·261	0·479 0·309	0·495 0·357	0·508 0·406	0·520 0·456	0·529 0·508	0·538 0·560	0·554 0·689	0·569 0·820	0·581 0·953	0·591 1·087	0·599 1·222	0·606 1·357
1·8	0·441 0·176	0·466 0·226	0·490 0·277	0·508 0·328	0·525 0·379	0·539 0·431	0·552 0·484	0·562 0·539	0·571 0·594	0·588 0·731	0·604 0·870	0·617 1·012	0·627 1·154	0·636 1·297	0·643 1·440
2·0	0·464 0·186	0·490 0·239	0·516 0·292	0·535 0·345	0·554 0·399	0·568 0·454	0·582 0·510	0·592 0·568	0·602 0·626	0·619 0·770	0·636 0·916	0·651 1·066	0·661 1·216	0·670 1·367	0·678 1·519
2·2	0·487 0·195	0·515 0·250	0·542 0·306	0·562 0·362	0·581 0·419	0·596 0·477	0·610 0·536	0·621 0·596	0·632 0·657	0·650 0·808	0·667 0·961	0·680 1·115	0·691 1·271	0·701 1·431	0·711 1·592
2·4	0·509 0·204	0·538 0·261	0·566 0·319	0·587 0·378	0·607 0·438	0·622 0·498	0·637 0·559	0·648 0·621	0·659 0·685	0·678 0·843	0·697 1·004	0·712 1·167	0·724 1·332	0·734 1·497	0·742 1·662
2·6	0·530 0·212	0·560 0·272	0·589 0·333	0·610 0·394	0·631 0·456	0·647 0·518	0·663 0·582	0·675 0·647	0·686 0·713	0·706 0·877	0·725 1·044	0·740 1·212	0·752 1·383	0·763 1·556	0·773 1·731
2·8	0·550 0·220	0·581 0·282	0·611 0·345	0·633 0·409	0·655 0·473	0·672 0·538	0·688 0·604	0·700 0·671	0·712 0·740	0·733 0·911	0·753 1·084	0·769 1·260	0·782 1·438	0·793 1·618	0·803 1·799
3·0	0·569 0·228	0·601 0·292	0·633 0·357	0·656 0·422	0·678 0·488	0·695 0·556	0·712 0·625	0·725 0·695	0·737 0·766	0·759 0·948	0·780 1·122	0·795 1·302	0·807 1·485	1·819 1·671	1·830 1·859

CLASS II. ($n = 0\cdot030.$)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 0·6.

For Bottom-Widths of

Fall per thousand.	0·6	0·8	1·0	1·2	1·4	1·6	1·8	2·0	2·5	3·0	3·5	4·0	4·5	5·0	5·5
0·1	0·134 0·121	0·140 0·144	0·146 0·168	0·151 0·192	0·156 0·216	0·160 0·240	0·163 0·264	0·166 0·289	0·173 0·352	0·178 0·416	0·182 0·480	0·185 0·544	0·188 0·609	0·191 0·676	0·194 0·743
0·2	0·196 0·176	0·206 0·210	0·215 0·244	0·221 0·278	0·227 0·313	0·232 0·348	0·237 0·384	0·242 0·421	0·252 0·512	0·258 0·604	0·264 0·697	0·269 0·791	0·274 0·887	0·278 0·984	0·282 1·081
0·3	0·244 0·220	0·255 0·262	0·265 0·304	0·274 0·346	0·282 0·389	0·288 0·432	0·293 0·475	0·298 0·519	0·311 0·633	0·319 0·748	0·327 0·863	0·333 0·979	0·338 1·096	0·343 1·214	0·348 1·332
0·4	0·283 0·255	0·295 0·303	0·307 0·352	0·317 0·401	0·326 0·450	0·333 0·500	0·340 0·552	0·347 0·604	0·361 0·735	0·370 0·867	0·379 1·000	0·386 1·134	0·392 1·270	0·398 1·409	0·404 1·648
0·5	0·317 0·285	0·331 0·338	0·344 0·392	0·355 0·447	0·365 0·508	0·374 0·561	0·382 0·620	0·391 0·680	0·405 0·827	0·416 0·975	0·426 1·125	0·434 1·276	0·441 1·429	0·448 1·586	0·455 1·743
0·6	0·348 0·313	0·363 0·372	0·378 0·432	0·390 0·493	0·401 0·554	0·410 0·615	0·418 0·678	0·426 0·741	0·442 0·903	0·454 1·066	0·466 1·230	0·474 1·395	0·482 1·562	0·489 1·731	0·496 1·901
0·7	0·378 0·340	0·394 0·403	0·410 0·467	0·423 0·532	0·435 0·598	0·444 0·666	0·453 0·735	0·462 0·804	0·480 0·980	0·493 1·157	0·506 1·335	0·514 0·514	0·522 1·694	0·530 1·876	0·538 2·059
0·8	0·405 0·364	0·423 0·432	0·439 0·501	0·453 0·578	0·465 0·647	0·475 0·712	0·485 0·787	0·495 0·861	0·513 1·047	0·527 1·234	0·539 1·423	0·550 1·613	0·558 1·805	0·564 1·997	0·570 2·189
0·9	0·432 0·389	0·450 0·462	0·467 0·536	0·481 0·610	0·495 0·684	0·506 0·759	0·516 0·836	0·526 0·915	0·546 1·115	0·561 1·316	0·575 1·518	0·585 1·722	0·594 1·927	0·603 2·184	0·612 2·342

1·0	0·455 0·409	0·474 0·485	0·492 0·562	0·507 0·640	0·522 0·720	0·533 0·800	0·544 0·882	0·555 0·966	0·576 1·177	0·592 1·389	0·607 1·602	0·617 1·816	0·627 2·032	0·636 2·251	0·645 2·471
1·2	0·498 0·448	0·520 0·532	0·539 0·617	0·556 0·702	0·572 0·788	0·584 0·876	0·596 0·966	0·608 1·058	0·630 1·287	0·648 1·519	0·665 1·755	0·678 1·994	0·690 2·237	0·702 2·485	0·714 2·735
1·4	0·538 0·484	0·560 0·574	0·582 0·666	0·600 0·769	0·618 0·852	0·631 0·946	0·644 1·043	0·657 1·143	0·681 1·392	0·700 1·643	0·718 1·895	0·730 2·148	0·741 2·404	0·752 2·662	0·763 2·922
1·6	0·576 0·518	0·600 0·613	0·622 0·710	0·641 0·809	0·660 0·909	0·674 1·011	0·688 1·115	0·702 1·221	0·728 1·487	0·748 1·755	0·767 2·025	0·780 2·297	0·792 2·571	0·804 2·846	0·816 3·121
1·8	0·610 0·549	0·635 0·649	0·660 0·751	0·680 0·855	0·700 0·962	0·715 1·072	0·730 1·184	0·745 1·296	0·772 1·577	0·793 1·861	0·814 2·149	0·828 2·439	0·841 2·731	0·854 3·023	0·867 3·316
2·0	0·643 0·579	0·670 0·685	0·696 0·793	0·717 0·904	0·738 1·017	0·754 1·131	0·769 1·247	0·784 1·364	0·814 1·662	0·836 1·962	0·858 2·265	0·872 2·569	0·886 2·875	0·899 3·182	0·912 3·490
2·2	0·675 0·607	0·703 0·717	0·730 0·830	0·752 0·946	0·774 1·065	0·791 1·186	0·807 1·309	0·823 1·432	0·854 1·744	0·877 2·059	0·900 2·376	0·915 2·695	0·929 3·016	0·943 3·338	0·957 3·661
2·4	0·705 0·634	0·734 0·751	0·762 0·870	0·786 0·991	0·809 1·114	0·826 1·239	0·843 1·367	0·860 1·496	0·892 1·821	0·916 2·149	0·940 2·481	0·955 2·815	0·970 3·150	0·985 3·486	1·000 3·823
2·6	0·734 0·661	0·765 0·783	0·794 0·907	0·819 1·033	0·842 1·161	0·860 1·290	0·877 1·323	0·895 1·557	0·928 1·897	0·947 2·239	0·978 2·582	0·994 2·927	1·010 3·276	1·025 3·628	1·040 3·982
2·8	0·761 0·685	0·793 0·812	0·823 0·941	0·848 1·072	0·873 1·205	0·892 1·338	0·910 1·475	0·928 1·614	0·963 1·966	0·990 2·321	1·015 2·680	1·032 3·041	1·048 3·403	1·064 3·766	1·080 4·130
3·0	0·788 0·709	0·820 0·840	0·852 0·973	0·878 1·108	0·904 1·245	0·923 1·384	0·942 1·527	0·961 1·672	0·997 2·038	1·025 2·406	1·051 2·775	1·068 3·146	1·085 3·520	1·101 3·897	1·117 4·277

CLASS II. ($n = 0\cdot030$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 0·8.

For Bottom-Widths of

Fall per thousand.	1·0	1·2	1·4	1·6	1·8	2·0	2·5	3·0	3·5	4·0	4·5	5·0	5·5	6·0	6·5
0·05	0·122	0·126	0·129	0·133	0·136	0·138	0·143	0·148	0·151	0·154	0·157	0·160	0·162	0·164	0·166
	0·215	0·242	0·270	0·298	0·325	0·353	0·424	0·496	0·568	0·642	0·717	0·793	0·869	0·945	1·022
0·1	0·176	0·182	0·188	0·192	0·196	0·199	0·206	0·213	0·218	0·222	0·226	0·230	0·233	0·236	0·238
	0·310	0·350	0·390	0·430	0·470	0·510	0·602	0·705	0·820	0·926	1·033	1·140	1·248	1·357	1·466
0·2	0·255	0·263	0·271	0·277	0·282	0·287	0·297	0·307	0·314	0·321	0·326	0·330	0·335	0·339	0·342
	0·449	0·506	0·563	0·620	0·677	0·735	0·882	1·030	1·180	1·331	1·483	1·637	1·792	1·948	2·106
0·3	0·316	0·326	0·336	0·343	0·349	0·355	0·367	0·379	0·388	0·395	0·402	0·408	0·413	0·418	0·421
	0·556	0·627	0·698	0·768	0·839	0·910	1·091	1·274	1·459	1·646	1·834	2·023	2·212	2·402	2·593
0·4	0·367	0·378	0·388	0·396	0·403	0·410	0·424	0·438	0·449	0·457	0·465	0·472	0·478	0·483	0·487
	0·646	0·726	0·806	0·887	0·968	1·049	1·260	1·473	1·688	1·905	2·123	2·341	2·560	2·780	3·000
0·5	0·410	0·422	0·434	0·443	0·451	0·459	0·474	0·489	0·501	0·510	0·519	0·527	0·534	0·540	0·544
	0·721	0·811	0·901	0·992	1·083	1·175	1·408	1·644	1·884	2·125	2·368	2·614	2·860	3·106	3·351
0·6	0·451	0·464	0·477	0·486	0·495	0·504	0·521	0·538	0·551	0·561	0·571	0·579	0·587	0·593	0·598
	0·794	0·892	0·990	1·089	1·189	1·290	1·549	1·810	2·072	2·336	2·602	2·871	3·142	3·413	3·684
0·7	0·487	0·501	0·515	0·525	0·535	0·545	0·564	0·581	0·595	0·606	0·617	0·626	0·634	0·640	0·645
	0·857	0·962	1·068	1·176	1·285	1·395	1·673	1·954	2·237	2·523	2·812	3·104	3·394	3·684	3·975
0·8	0·522	0·538	0·553	0·565	0·575	0·585	0·605	0·623	0·638	0·650	0·662	0·672	0·680	0·687	0·693
	0·919	1·034	1·149	1·265	1·381	1·497	1·798	2·099	2·399	2·710	3·021	3·333	3·645	3·957	4·269

0·9	0·554 0·975	0·571 1·097	0·586 1·219	0·599 1·342	0·611 1·464	0·620 1·587	0·642 1·897	0·661 2·215	0·676 2·541	0·689 2·870	0·701 3·200	0·712 3·530	0·721 3·860	0·729 4·193	0·735 4·528
1·0	0·589 1·036	0·605 1·161	0·618 1·286	0·630 1·411	0·642 1·540	0·652 1·669	0·676 2·000	0·696 2·337	0·713 2·681	0·727 3·029	0·740 3·377	0·751 3·725	0·760 4·073	0·767 4·421	0·774 4·768
1·2	0·640 1·126	0·660 1·267	0·677 1·408	0·692 1·550	0·705 1·691	0·716 1·833	0·740 2·193	0·763 2·560	0·780 2·933	0·796 3·313	0·810 3·694	0·822 4·076	0·832 4·459	0·841 4·842	0·848 5·225
1·4	0·691 1·216	0·712 1·368	0·731 1·520	0·746 1·671	0·760 1·823	0·772 1·976	0·799 2·366	0·822 2·763	0·842 3·167	0·860 3·577	0·875 3·989	0·888 4·404	0·899 4·819	0·909 5·234	0·917 5·648
1·6	0·739 1·301	0·762 1·463	0·782 1·625	0·798 1·788	0·813 1·951	0·826 2·114	0·856 2·534	0·881 2·960	0·902 3·392	0·919 3·828	0·935 4·266	0·949 4·706	0·961 5·148	0·971 5·592	0·980 6·037
1·8	0·783 1·378	0·807 1·549	0·829 1·721	0·846 1·895	0·862 2·070	0·877 2·245	0·907 2·684	0·934 3·133	0·955 3·591	0·975 4·057	0·992 4·525	1·007 4·994	1·020 5·464	1·031 5·935	1·040 6·407
2·0	0·834 1·468	0·855 1·643	0·874 1·820	0·892 1·998	0·908 2·179	0·923 2·362	0·956 2·828	0·985 3·304	1·008 3·791	1·028 4·281	1·046 4·773	1·062 5·267	1·075 5·762	1·086 6·257	1·096 6·752
2·2	0·866 1·524	0·892 1·715	0·916 1·906	0·936 2·097	0·953 2·289	0·969 2·481	1·002 2·970	1·033 3·469	1·058 3·978	1·078 4·492	1·097 5·008	1·114 5·525	1·128 6·043	1·140 6·563	1·150 7·085
2·4	0·905 1·593	0·933 1·792	0·958 1·991	0·978 2·191	0·996 2·390	1·012 2·590	1·047 3·103	1·079 3·626	1·106 4·158	1·126 4·692	1·145 5·228	1·163 5·767	1·178 6·307	1·190 6·849	1·200 7·393
2·6	0·942 1·658	0·970 1·863	0·997 2·070	1·017 2·278	1·036 2·488	1·054 2·698	1·090 3·230	1·122 3·772	1·150 4·824	1·173 4·881	1·193 5·440	1·211 6·000	1·226 6·561	1·238 7·124	1·248 7·688
2·8	0·977 1·719	1·007 1·934	1·034 2·149	1·056 2·365	1·075 2·580	1·098 2·795	1·130 3·350	1·165 3·915	1·194 4·490	1·216 5·070	1·238 5·651	1·257 6·234	1·272 6·817	1·285 7·400	1·296 7·984
3·0	1·011 1·779	1·042 2·001	1·070 2·225	1·094 2·451	1·116 2·679	1·136 2·908	1·174 3·4[illegible]	1·208 4·064	1·238 4·658	1·264 5·259	1·286 5·860	1·304 6·460	1·319 7·060	1·331 7·660	1·341 8·261

CLASS II. (n = 0·030.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 1·0.

For Bottom-Widths of

Fall per thousand.	2·0	2·5	3·0	3·5	4·0	4·5	5·0	5·5	6·0	6·5	7·0	7·5	8·0	8·5	9·0
0·05	0·159	0·166	0·171	0·176	0·180	0·184	0·187	0·190	0·192	0·194	0·196	0·198	0·200	0·201	0·202
	0·558	0·664	0·772	0·880	0·992	1·104	1·316	1·329	1·442	1·555	1·668	1·782	1·896	2·010	2·124
0·1	0·231	0·240	0·248	0·254	0·260	0·265	0·269	0·273	0·276	0·279	0·282	0·284	0·286	0·288	0·289
	0·818	0·960	1·114	1·270	1·429	1·590	1·751	1·911	2·072	2·233	2·394	2·556	2·718	2·880	3·042
0·2	0·330	0·341	0·351	0·361	0·368	0·375	0·381	0·386	0·390	0·394	0·398	0·401	0·404	0·407	0·409
	1·146	1·364	1·583	1·805	2·027	2·251	2·476	2·701	2·927	3·153	3·371	3·609	3·839	4·070	4·301
0·3	0·407	0·421	0·433	0·443	0·453	0·461	0·468	0·474	0·479	0·484	0·489	0·493	0·497	0·500	0·503
	1·420	1·684	1·945	2·215	2·489	2·766	3·042	3·318	3·595	3·872	4·152	4·435	4·717	5·000	5·283
0·4	0·470	0·486	0·500	0·512	0·523	0·532	0·540	0·547	0·553	0·559	0·564	0·569	0·573	0·577	0·580
	1·644	1·944	2·248	2·560	2·875	3·192	3·509	3·829	4·150	4·472	4·796	5·121	5·445	5·770	6·094
0·5	0·516	0·543	0·560	0·574	0·586	0·597	0·606	0·614	0·621	0·627	0·633	0·638	0·642	0·646	0·650
	1·832	2·172	2·517	2·870	3·225	3·582	3·940	4·298	4·656	5·015	5·374	5·743	6·101	6·460	6·819
0·6	0·577	0·597	0·615	0·631	0·644	0·655	0·665	0·673	0·680	0·687	0·693	0·698	0·703	0·708	0·713
	2·008	2·388	2·769	3·155	3·542	3·930	4·320	4·711	5·103	5·496	5·888	6·283	6·680	7·080	7·480
0·7	0·623	0·643	0·663	0·681	0·696	0·708	0·718	0·727	0·735	0·742	0·749	0·755	0·760	0·765	0·770
	2·160	2·572	2·986	3·405	3·826	4·247	4·668	5·090	5·513	5·936	6·364	6·793	7·220	7·650	8·080
0·8	0·668	0·694	0·714	0·730	0·744	0·759	0·770	0·780	0·788	0·795	0·803	0·809	0·815	0·820	0·824
	2·354	2·776	3·208	3·650	4·102	4·554	5·007	5·460	5·910	6·361	6·820	7·280	7·740	8·200	8·660

0·9	0·709 2·494	0·736 2·944	0·758 3·404	0·775 3·875	0·792 4·352	0·805 4·830	0·817 5·309	0·827 5·789	0·835 6·270	0·844 6·752	0·852 7·241	0·859 7·730	0·865 8·220	0·871 8·710	0·875 9·200
1·0	0·747 2·620	0·776 3·104	0·798 3·594	0·818 4·090	0·834 4·591	0·849 5·094	0·860 5·598	0·872 6·104	0·880 6·611	0·890 7·120	0·898 7·632	0·905 8·145	0·911 8·657	0·917 9·170	0·921 9·683
1·2	0·819 2·880	0·850 3·400	0·877 3·930	0·894 4·470	0·913 5·020	0·929 5·574	0·943 6·129	0·955 6·685	0·965 7·242	0·975 7·800	0·983 8·359	0·991 8·919	0·998 9·478	1·004 10·04	1·009 10·60
1·4	0·884 3·105	0·918 3·672	0·944 4·245	0·966 4·830	0·987 5·426	1·004 6·023	1·018 6·620	1·031 7·217	1·042 7·820	1·053 8·423	1·062 9·026	1·070 9·630	1·078 10·23	1·084 10·84	1·089 11·45
1·6	0·945 3·325	0·982 3·928	1·010 4·541	1·033 5·165	1·053 5·693	1·071 6·426	1·088 7·069	1·102 7·713	1·114 8·356	1·125 9·000	1·135 9·645	1·144 10·29	1·152 10·94	1·159 11·59	1·165 12·24
1·8	1·003 3·581	1·048 4·192	1·071 4·823	1·095 5·475	1·117 6·146	1·137 6·822	1·154 7·502	1·169 8·183	1·181 8·863	1·193 9·544	1·204 10·23	1·213 10·91	1·221 11·60	1·229 12·29	1·235 12·98
2·0	1·057 3·775	1·097 4·388	1·129 5·021	1·155 5·775	1·180 6·485	1·200 7·200	1·218 7·915	1·233 8·631	1·245 9·345	1·257 10·06	1·269 10·79	1·280 11·52	1·289 12·24	1·296 12·96	1·302 13·68
2·2	1·109 3·881	1·151 4·604	1·184 5·328	1·211 6·055	1·237 6·803	1·260 7·560	1·277 8·300	1·292 9·044	1·306 9·795	1·319 10·55	1·331 11·31	1·341 12·07	1·351 12·83	1·359 13·59	1·366 14·35
2·4	1·158 4·053	1·202 4·808	1·237 5·566	1·265 6·325	1·293 7·111	1·316 7·896	1·334 8·671	1·350 9·450	1·364 10·23	1·378 11·02	1·391 11·82	1·402 12·62	1·412 13·41	1·421 14·21	1·428 15·01
2·6	1·205 4·217	1·251 5·004	1·288 5·796	1·318 6·590	1·345 7·397	1·369 8·214	1·388 9·022	1·405 9·835	1·420 10·65	1·434 11·47	1·447 12·29	1·458 13·12	1·469 13·94	1·477 14·77	1·485 15·59
2·8	1·251 4·378	1·299 5·196	1·336 6·012	1·367 6·835	1·396 7·678	1·421 8·526	1·440 9·380	1·458 10·11	1·473 11·05	1·488 11·90	1·503 12·76	1·515 13·62	1·525 14·47	1·533 15·33	1·540 16·19
3·0	1·295 4·532	1·344 5·376	1·383 6·223	1·416 7·080	1·446 7·953	1·471 8·826	1·486 9·647	1·509 10·56	1·525 11·44	1·540 12·32	1·555 13·21	1·567 14·10	1·578 14·98	1·587 15·87	1·595 16·76

CLASS II. (n = 0·30.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 1·2.

For Bottom-Widths of

Fall per thousand.	3·5	4·0	4·5	5·0	5·5	6·0	6·5	7·0	7·5	8·0	8·5	9·0	9·5	10	11
0·05	0·198	0·203	0·207	0·211	0·214	0·217	0·220	0·223	0·225	0·227	0·229	0·230	0·232	0·234	0·236
	1·262	1·413	1·565	1·722	1·874	2·031	2·191	2·355	2·511	2·669	2·831	2·980	3·145	3·313	3·625
0·1	0·284	0·291	0·296	0·301	0·305	0·309	0·313	0·316	0·318	0·321	0·323	0·325	0·328	0·331	0·333
	1·806	2·025	2·237	2·456	2·672	2·892	3·117	3·337	3·549	3·775	3·992	4·212	4·447	4·687	5·114
0·2	0·401	0·411	0·419	0·425	0·431	0·437	0·442	0·446	0·450	0·454	0·457	0·460	0·464	0·468	0·472
	2·550	2·860	3·167	3·468	3·776	4·091	4·402	4·710	5·022	5·339	5·648	5·962	6·292	6·627	7·249
0·3	0·493	0·505	0·514	0·522	0·530	0·537	0·543	0·548	0·552	0·557	0·561	0·565	0·570	0·574	0·578
	3·135	3·515	3·886	4·260	4·643	5·027	5·409	5·786	6·160	6·551	6·934	7·322	7·729	8·128	8·878
0·4	0·569	0·583	0·594	0·603	0·612	0·620	0·627	0·632	0·637	0·643	0·648	0·653	0·658	0·663	0·667
	3·619	4·058	4·491	4·920	5·360	5·804	6·245	6·674	7·109	7·561	8·009	8·463	8·923	9·389	10·24
0·5	0·639	0·652	0·664	0·676	0·684	0·693	0·701	0·707	0·712	0·718	0·724	0·730	0·736	0·741	0·746
	4·064	4·538	5·020	5·516	5·992	6·486	6·982	7·466	7·945	8·443	8·950	9·460	9·979	10·49	11·46
0·6	0·700	0·714	0·727	0·738	0·749	0·759	0·768	0·774	0·780	0·787	0·793	0·799	0·805	0·811	0·817
	4·452	4·969	5·497	6·021	6·561	7·104	7·649	8·173	8·706	9·256	9·802	10·35	10·91	11·48	12·55
0·7	0·756	0·772	0·786	0·798	0·809	0·820	0·830	0·837	0·843	0·850	0·857	0·863	0·870	0·877	0·883
	4·808	5·373	5·942	6·512	7·086	7·675	8·266	8·839	9·408	9·996	10·59	11·18	11·80	12·42	13·56
0·8	0·811	0·827	0·840	0·853	0·865	0·876	0·887	0·894	0·901	0·908	0·915	0·922	0·928	0·934	0·943
	5·158	5·756	6·350	6·960	7·577	8·200	8·835	9·441	10·05	10·68	11·31	11·95	12·58	13·22	14·48

0·9	0·860 5·470	0·878 6·111	0·891 6·736	0·905 7·384	0·917 8·033	0·930 8·706	0·941 9·371	0·949 10·02	0·957 10·68	0·965 11·35	0·972 12·02	0·979 12·69	0·985 13·36	0·991 14·03	1·000 15·36
1·0	0·906 5·762	0·925 6·437	0·939 7·099	0·953 7·777	0·967 8·470	0·980 9·173	0·992 9·881	1·001 10·56	1·009 11·26	1·017 11·96	1·024 12·66	1·032 13·37	1·038 14·08	1·044 14·78	1·054 16·19
1·2	0·992 6·310	1·013 7·050	1·029 7·779	1·045 8·527	1·059 9·277	1·073 10·04	1·086 10·82	1·096 11·57	1·105 12·28	1·114 13·10	1·122 13·82	1·130 14·64	1·137 15·37	1·144 16·20	1·153 17·71
1·4	1·072 6·817	1·095 7·621	1·111 8·399	1·128 9·205	1·144 10·02	1·160 10·86	1·174 11·69	1·183 12·49	1·192 13·31	1·202 14·14	1·212 14·98	1·221 15·82	1·229 16·66	1·237 17·51	1·247 19·15
1·6	1·146 7·288	1·170 8·143	1·188 8·981	1·208 9·858	1·225 10·73	1·240 11·60	1·255 12·47	1·265 13·35	1·274 14·23	1·285 15·11	1·295 16·01	1·305 16·91	1·313 17·81	1·321 18·71	1·333 20·47
1·8	1·216 7·734	1·241 8·638	1·260 9·526	1·279 10·44	1·298 11·37	1·315 12·31	1·331 13·23	1·341 14·16	1·351 15·09	1·363 16·03	1·374 16·99	1·385 17·95	1·394 18·91	1·403 19·87	1·414 21·72
2·0	1·281 8·147	1·308 9·103	1·328 10·04	1·349 11·01	1·368 11·99	1·387 12·98	1·403 13·95	1·414 14·93	1·424 15·91	1·436 16·89	1·448 17·90	1·459 18·91	1·469 19·92	1·479 20·94	1·491 22·90
2·2	1·344 8·549	1·372 9·550	1·393 10·53	1·414 11·54	1·434 12·57	1·453 13·60	1·471 14·63	1·483 15·66	1·494 16·69	1·507 17·73	1·519 18·78	1·531 19·84	1·541 20·90	1·551 21·96	1·563 24·00
2·4	1·404 8·929	1·433 9·975	1·455 11·00	1·478 12·06	1·498 13·13	1·518 14·21	1·537 15·28	1·549 16·36	1·560 17·43	1·573 18·50	1·586 19·60	1·599 20·71	1·609 21·81	1·619 22·92	1·633 25·08
2·6	1·461 9·292	1·492 10·38	1·514 11·44	1·538 12·55	1·559 13·67	1·580 14·79	1·599 15·90	1·612 17·02	1·624 18·14	1·638 19·26	1·651 20·41	1·664 21·56	1·675 22·71	1·686 23·87	1·700 26·11
2·8	1·516 9·643	1·548 10·77	1·572 11·88	1·596 13·02	1·618 14·18	1·640 15·35	1·660 16·51	1·673 17·67	1·685 18·82	1·699 19·98	1·713 21·18	1·727 22·38	1·740 23·61	1·755 24·85	1·764 27·09
3·0	1·569 9·979	1·602 11·15	1·627 12·30	1·652 13·48	1·675 14·68	1·697 15·88	1·718 17·08	1·732 18·29	1·745 19·49	1·759 20·69	1·773 21·92	1·787 23·16	1·800 24·41	1·812 25·66	1·826 28·05

CLASS II. ($n = 0{\cdot}30$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 1·4.

For Bottom-Widths of

Fall per thousand.	5·0	5·5	6·0	6·5	7·0	7·5	8·0	8·5	9·0	9·5	10	11	12	13	14
0·05	0·234 2·326	0·237 2·522	0·240 2·721	0·243 2·925	0·246 3·134	0·249 3·347	0·251 3·549	0·253 3·754	0·256 3·978	0·258 4·190	0·260 4·405	0·263 4·824	0·266 5·250	0·268 5·665	0·270 6·086
0·1	0·331 3·290	0·335 3·565	0·340 3·856	0·344 4·142	0·348 4·433	0·351 4·717	0·354 5·006	0·357 5·298	0·360 5·595	0·363 5·895	0·365 6·183	0·369 6·767	0·373 7·364	0·377 7·969	0·380 8·564
0·2	0·468 4·652	0·475 5·054	0·480 5·443	0·485 5·840	0·490 6·243	0·494 6·639	0·499 7·055	0·503 7·465	0·507 7·880	0·510 8·283	0·513 8·690	0·518 9·500	0·523 10·32	0·528 11·16	0·532 11·99
0·3	0·573 5·695	0·581 6·182	0·588 6·668	0·594 7·152	0·600 7·644	0·606 8·145	0·611 8·640	0·616 9·141	0·621 9·649	0·625 10·15	0·629 10·65	0·638 11·70	0·647 12·77	0·652 13·79	0·657 14·81
0·4	0·662 6·580	0·671 7·140	0·679 7·700	0·686 8·260	0·693 8·829	0·700 9·408	0·706 9·984	0·712 10·56	0·717 11·14	0·722 11·72	0·726 12·30	0·733 13·46	0·740 14·63	0·747 15·80	0·753 16·97
0·5	0·740 7·355	0·750 7·980	0·759 8·606	0·767 9·234	0·775 9·874	0·782 10·27	0·789 11·15	0·796 11·81	0·802 12·45	0·807 13·10	0·812 13·75	0·820 15·05	0·828 16·35	0·835 17·65	0·841 18·95
0·6	0·810 8·052	0·822 8·746	0·831 9·423	0·839 10·10	0·848 10·80	0·857 11·51	0·864 12·22	0·871 12·93	0·877 13·64	0·883 14·35	0·889 15·06	0·898 16·49	0·907 17·92	0·915 19·35	0·922 20·78
0·7	0·875 8·698	0·888 9·449	0·899 10·19	0·908 10·93	0·917 11·68	0·925 12·43	0·933 13·19	0·941 13·95	0·948 14·72	0·954 15·49	0·960 16·26	0·970 17·80	0·979 19·35	0·989 20·90	0·996 22·45
0·8	0·936 9·307	0·949 10·10	0·960 10·89	0·970 11·68	0·980 12·48	0·989 13·29	0·998 14·10	1·006 14·92	1·013 15·74	1·020 16·56	1·026 17·38	1·037 19·03	1·047 20·68	1·056 22·83	1·064 23·98

0·9	0·993 9·870	1·006 10·70	1·018 11·54	1·029 12·39	1·039 13·24	1·049 14·10	1·058 14·96	1·067 15·83	1·075 16·70	1·082 17·57	1·089 18·44	1·101 20·19	1·111 21·94	1·120 23·69	1·129 25·44
1·0	1·046 10·40	1·061 11·29	1·073 12·17	1·085 13·07	1·096 13·97	1·106 14·87	1·116 15·78	1·125 16·69	1·133 17·61	1·141 18·53	1·148 19·45	1·160 21·29	1·171 23·13	1·181 24·97	1·190 26·82
1·2	1·146 11·39	1·162 12·36	1·175 13·33	1·188 14·31	1·200 15·30	1·212 16·29	1·222 17·29	1·232 18·29	1·241 19·29	1·249 20·29	1·257 21·29	1·270 23·31	1·282 25·33	1·293 27·36	1·304 29·39
1·4	1·238 12·30	1·255 13·35	1·270 14·40	1·284 15·46	1·297 16·52	1·309 17·59	1·320 18·67	1·331 19·75	1·340 20·83	1·348 21·91	1·358 23·00	1·372 25·18	1·385 27·36	1·397 29·54	1·408 31·73
1·6	1·323 13·15	1·342 14·27	1·358 15·40	1·372 16·53	1·386 17·66	1·399 18·80	1·411 19·96	1·423 21·12	1·433 22·28	1·443 23·44	1·452 24·60	1·467 26·93	1·481 29·26	1·493 31·59	1·505 33·92
1·8	1·404 13·96	1·423 15·14	1·440 16·33	1·455 17·53	1·470 18·73	1·484 19·94	1·497 21·16	1·510 22·39	1·520 23·62	1·530 24·85	1·540 26·08	1·556 28·57	1·571 31·07	1·586 33·57	1·600 36·07
2·0	1·479 14·70	1·500 15·95	1·518 17·21	1·534 18·48	1·549 19·75	1·564 21·02	1·578 22·31	1·591 23·60	1·602 24·89	1·613 26·19	1·623 27·49	1·639 30·10	1·655 32·71	1·669 35·32	1·683 37·93
2·2	1·552 15·43	1·574 16·74	1·593 18·06	1·609 19·39	1·625 20·72	1·641 22·05	1·655 23·40	1·669 24·75	1·680 26·11	1·691 27·47	1·702 28·83	1·719 31·56	1·736 34·30	1·751 37·04	1·765 39·78
2·4	1·621 16·11	1·641 17·46	1·660 18·82	1·678 20·22	1·696 21·62	1·714 23·03	1·729 24·44	1·743 25·86	1·755 27·28	1·767 28·70	1·778 30·12	1·796 32·97	1·814 35·82	1·829 38·68	1·843 41·54
2·6	1·687 16·77	1·711 18·20	1·731 19·63	1·749 21·08	1·767 22·53	1·784 23·98	1·800 25·45	1·814 26·92	1·827 28·39	1·839 29·87	1·851 31·35	1·870 34·32	1·888 37·29	1·904 40·27	1·919 43·25
2·8	1·751 17·40	1·775 18·88	1·796 20·36	1·815 21·86	1·833 23·37	1·851 24·88	1·867 26·40	1·883 27·93	1·896 29·46	1·908 30·99	1·920 32·52	1·940 35·61	1·959 38·70	1·976 41·80	1·992 44·90
3·0	1·814 18·03	1·838 19·56	1·860 21·09	1·879 22·64	1·898 24·19	1·916 25·75	1·933 27·33	1·949 28·91	1·962 30·49	1·975 32·08	1·988 33·67	2·008 36·86	2·028 40·05	2·045 43·25	2·061 46·45

CLASS II. ($n = 0 \cdot 30$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 1·6.

For Bottom-Widths of

Fall per thousand.	7·0	7·5	8·0	8·5	9·0	9·5	10	11	12	13	14	15	16	17	18
0·05	0·269 4·046	0·272 4·308	0·275 4·576	0·278 4·848	0·280 5·107	0·282 5·369	0·284 5·635	0·288 6·175	0·291 6·705	0·293 7·219	0·296 7·767	0·298 8·296	0·300 8·832	0·302 9·374	0·304 9·922
0·1	0·378 5·685	0·381 6·053	0·385 6·408	0·388 6·767	0·391 7·132	0·394 7·502	0·397 7·876	0·401 8·598	0·405 9·330	0·409 10·08	0·413 10·82	0·416 11·56	0·419 12·31	0·421 13·06	0·423 13·81
0·2	0·531 7·986	0·536 8·490	0·541 9·001	0·545 9·504	0·550 10·03	0·554 10·55	0·558 11·07	0·565 12·10	0·570 13·13	0·575 14·17	0·579 15·22	0·583 16·27	0·587 17·32	0·591 18·37	0·595 19·42
0·3	0·650 9·777	0·656 10·39	0·661 11·00	0·666 11·61	0·671 12·23	0·676 12·86	0·680 13·49	0·688 14·74	0·694 15·99	0·700 17·24	0·706 18·50	0·712 19·77	0·716 21·04	0·720 22·32	0·723 23·60
0·4	0·751 11·29	0·758 12·00	0·764 12·71	0·769 13·42	0·775 14·13	0·780 14·85	0·785 15·57	0·794 17·02	0·802 18·47	0·809 19·93	0·816 21·38	0·822 22·84	0·826 24·30	0·830 25·76	0·834 27·22
0·5	0·837 12·59	0·842 13·34	0·850 14·14	0·858 14·94	0·864 15·74	0·870 16·55	0·875 17·36	0·885 18·97	0·893 20·59	0·901 22·21	0·909 23·85	0·916 25·50	0·922 27·15	0·928 28·80	0·933 30·45
0·6	0·917 13·79	0·923 14·62	0·932 15·50	0·940 16·38	0·947 17·26	0·953 18·14	0·959 19·03	0·970 20·79	0·979 22·56	0·988 24·34	0·996 26·13	1·004 27·93	1·010 29·70	1·016 31·55	1·022 33·36
0·7	0·991 14·90	0·997 15·79	1·006 16·73	1·015 17·68	1·022 18·63	1·029 19·58	1·035 20·53	1·047 22·44	1·057 24·36	1·067 26·29	1·076 28·23	1·084 30·18	1·091 32·13	1·098 34·08	1·104 36·03
0·8	1·059 15·92	1·066 16·88	1·076 17·89	1·085 18·90	1·093 19·92	1·100 20·94	1·107 21·96	1·120 23·98	1·130 26·02	1·140 28·09	1·150 30·17	1·159 32·25	1·166 34·33	1·173 36·42	1·180 38·51

0·9	1·123 16·89	1·131 17·91	1·141 18·98	1·151 20·05	1·159 21·13	1·167 22·21	1·174 23·29	1·187 25·44	1·198 27·60	1·209 29·79	1·219 31·99	1·229 34·20	1·237 36·41	1·244 38·62	1·251 40·83
1·0	1·184 17·81	1·192 18·88	1·203 20·01	1·213 21·14	1·222 22·28	1·230 23·42	1·238 24·56	1·252 26·82	1·264 29·10	1·275 31·41	1·286 33·73	1·296 36·06	1·304 38·39	1·312 40·72	1·319 43·05
1·2	1·297 19·06	1·305 20·67	1·317 21·91	1·329 23·15	1·338 24·40	1·347 25·65	1·356 26·90	1·371 29·39	1·384 31·89	1·397 34·42	1·409 36·96	1·420 39·51	1·429 42·06	1·437 44·61	1·445 47·16
1·4	1·399 21·04	1·410 22·33	1·423 23·67	1·435 25·02	1·445 26·37	1·455 27·72	1·465 29·07	1·481 31·75	1·495 34·45	1·509 37·18	1·521 39·93	1·533 42·68	1·543 45·43	1·552 48·18	1·561 50·94
1·6	1·498 22·53	1·507 23·87	1·521 25·30	1·534 26·74	1·545 28·18	1·556 29·62	1·566 31·07	1·583 33·94	1·598 36·83	1·613 39·75	1·626 42·69	1·639 45·63	1·649 48·58	1·659 51·53	1·669 54·48
1·8	1·589 23·90	1·599 25·33	1·614 26·83	1·629 27·34	1·640 28·86	1·651 30·40	1·661 32·95	1·679 36·00	1·695 39·07	1·711 42·16	1·725 45·27	1·738 48·39	1·749 51·51	1·760 54·64	1·770 57·77
2·0	1·675 25·19	1·685 26·69	1·701 28·24	1·716 29·82	1·728 31·43	1·740 33·07	1·751 34·74	1·770 37·94	1·787 41·17	1·803 44·42	1·818 47·69	1·833 50·97	1·844 54·26	1·855 57·56	1·865 60·87
2·2	1·756 26·41	1·767 27·99	1·783 29·61	1·799 31·26	1·812 32·94	1·824 34·66	1·836 36·42	1·857 39·79	1·875 43·18	1·891 46·59	1·907 50·02	1·922 53·47	1·934 56·93	1·946 60·40	1·957 63·87
2·4	1·834 27·58	1·846 29·24	1·863 30·94	1·879 32·67	1·892 34·43	1·905 36·22	1·918 38·05	1·939 41·55	1·957 45·09	1·975 48·66	1·992 52·25	2·007 55·85	2·020 59·45	2·032 63·06	2·043 66·68
2·6	1·909 28·71	1·921 30·43	1·939 32·20	1·956 34·00	1·970 35·83	1·983 37·69	1·996 39·60	2·018 43·26	2·037 46·95	2·056 50·66	2·073 54·39	2·090 58·14	2·103 61·90	2·115 65·66	2·127 69·42
2·8	1·981 29·79	1·994 31·59	2·012 33·43	2·030 35·29	2·044 37·19	2·058 39·12	2·071 41·09	2·094 44·88	2·114 48·70	2·133 52·55	2·151 56·42	2·168 60·31	2·182 64·21	2·195 68·12	2·207 72·03
3·0	2·051 30·85	2·064 32·70	2·083 34·61	2·101 36·55	2·117 38·52	2·132 40·52	2·144 42·54	2·168 46·46	2·190 50·41	2·208 54·40	2·226 58·40	2·244 62·42	2·260 66·44	2·273 70·52	2·285 74·58

CLASS II. ($n = 0·30.$)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 1·8.

For Bottom-Widths of

Fall per thousand.	9·0	9·5	10	11	12	13	14	15	16	17	18	19	20	21	22
0·05	0·302 6·361	0·304 6·676	0·306 6·995	0·310 7·645	0·313 8·282	0·316 8·930	0·319 9·589	0·322 10·26	0·324 10·92	0·326 11·58	0·328 12·24	0·330 12·90	0·332 13·56	0·334 14·22	0·335 14·88
0·1	0·420 8·845	0·423 9·289	0·426 9·739	0·431 10·50	0·436 11·44	0·440 12·38	0·444 13·31	0·447 14·24	0·450 15·16	0·453 16·08	0·456 17·00	0·458 17·92	0·461 18·84	0·463 19·76	0·465 20·68
0·2	0·589 12·40	0·593 13·02	0·597 13·65	0·604 14·90	0·610 16·16	0·616 17·42	0·621 18·68	0·626 19·94	0·630 21·21	0·634 22·48	0·637 23·75	0·640 25·03	0·644 26·31	0·647 27·59	0·650 28·87
0·3	0·719 15·14	0·723 15·88	0·727 16·62	0·735 18·15	0·743 19·68	0·750 21·21	0·757 22·74	0·762 24·28	0·767 25·82	0·772 27·36	0·776 28·90	0·780 30·45	0·783 32·00	0·786 33·55	0·789 35·10
0·4	0·830 17·48	0·835 18·34	0·840 19·20	0·850 20·97	0·859 22·74	0·867 24·51	0·874 26·27	0·880 28·03	0·885 29·79	0·890 31·55	0·894 33·31	0·898 35·08	0·902 36·85	0·906 38·62	0·909 40·39
0·5	0·925 19·48	0·931 20·45	0·937 21·42	0·948 23·38	0·958 24·35	0·966 26·32	0·974 28·29	0·981 31·26	0·988 33·24	0·994 35·23	1·000 37·23	1·005 39·23	1·009 41·23	1·013 43·23	1·017 45·23
0·6	1·013 21·33	1·020 22·40	1·027 23·47	1·039 25·62	1·050 27·77	1·060 29·93	1·068 32·19	1·075 34·25	1·082 36·41	1·088 38·58	1·094 40·76	1·100 42·95	1·105 45·15	1·110 47·35	1·114 49·55
0·7	1·095 23·06	1·102 24·25	1·109 25·35	1·122 27·67	1·134 30·00	1·144 32·33	1·153 34·66	1·161 36·99	1·169 39·33	1·176 41·68	1·183 44·04	1·189 46·41	1·194 48·79	1·199 51·17	1·204 54·06
0·8	1·170 24·64	1·178 25·87	1·186 27·11	1·200 29·60	1·212 32·09	1·223 34·58	1·233 37·07	1·242 39·57	1·250 42·07	1·257 44·58	1·264 47·10	1·271 49·63	1·277 52·18	1·282 54·78	1·287 57·28

0·9	1·241 26·13	1·250 27·44	1·258 28·76	1·273 31·39	1·285 34·03	1·296 36·67	1·307 39·31	1·317 41·96	1·326 44·61	1·333 47·27	1·340 49·93	1·347 52·60	1·353 55·28	1·359 57·96	1·365 60·65
1·0	1·309 27·57	1·317 28·94	1·326 30·31	1·342 33·10	1·355 35·89	1·367 38·68	1·379 41·47	1·389 44·26	1·398 47·06	1·406 49·86	1·413 52·66	1·420 55·46	1·426 58·26	1·432 61·06	1·438 63·86
1·2	1·434 30·20	1·443 31·69	1·452 33·19	1·469 36·24	1·484 39·29	1·498 42·34	1·510 45·40	1·521 48·46	1·531 51·52	1·540 54·59	1·548 57·67	1·556 60·76	1·563 63·87	1·570 66·98	1·576 70·10
1·4	1·549 32·62	1·559 34·23	1·568 35·84	1·587 39·14	1·603 42·44	1·618 45·74	1·631 49·04	1·643 52·35	1·654 55·66	1·663 58·98	1·672 62·31	1·681 65·64	1·688 68·98	1·695 72·33	1·702 75·68
1·6	1·655 34·86	1·666 36·60	1·677 38·34	1·697 41·85	1·714 45·37	1·730 48·89	1·744 52·42	1·756 55·95	1·768 59·49	1·778 63·04	1·788 66·60	1·797 70·17	1·805 73·76	1·812 77·36	1·819 80·96
1·8	1·756 36·98	1·768 38·82	1·779 40·67	1·800 44·39	1·818 48·12	1·835 51·86	1·858 55·61	1·863 59·36	1·875 63·12	1·886 66·89	1·896 70·66	1·906 74·43	1·914 78·20	1·922 81·98	1·930 85·76
2·0	1·851 38·98	1·863 40·92	1·875 42·87	1·897 46·81	1·917 50·75	1·934 54·69	1·949 58·63	1·964 62·58	1·977 66·54	1·988 70·51	1·999 74·49	2·009 78·47	2·018 82·45	2·026 86·44	2·034 90·43
2·2	1·941 40·88	1·954 42·91	1·966 44·95	1·990 49·07	2·010 53·20	2·028 57·34	2·045 61·48	2·060 65·63	2·073 69·78	2·085 73·94	2·096 78·11	2·107 82·28	2·116 86·46	2·125 90·64	2·133 94·82
2·4	2·027 42·69	2·041 44·82	2·054 46·96	2·078 51·26	2·099 55·57	2·118 59·89	2·136 64·21	2·151 68·53	2·165 72·87	2·177 77·23	2·189 81·60	2·201 85·97	2·211 90·35	2·220 94·73	2·229 99·12
2·6	2·110 44·43	2·124 46·65	2·138 48·88	2·162 53·37	2·185 57·87	2·205 62·37	2·223 66·87	2·240 71·37	2·254 75·88	2·266 80·40	2·278 84·92	2·290 89·44	2·300 93·97	2·310 98·50	2·320 103·0
2·8	2·190 46·12	2·204 48·41	2·218 50·70	2·244 55·35	2·268 60·00	2·288 64·66	2·306 69·33	2·323 74·01	2·338 78·70	2·351 83·40	2·364 88·11	2·377 92·82	2·387 97·54	2·397 102·3	2·407 107·0
3·0	2·267 47·74	2·282 50·11	2·296 52·48	2·323 57·28	2·347 62·09	2·368 66·91	2·387 71·75	2·404 76·60	2·421 81·46	2·434 86·33	2·447 91·21	2·460 96·10	2·471 101·0	2·481 105·9	2·491 110·8

CLASS II. ($n = 0 \cdot 30.$)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 2·0.

For Bottom-Widths of

Fall per thousand.	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
0·05	0·336 10·08	0·339 10·86	0·342 11·64	0·345 12·42	0·347 13·21	0·350 14·00	0·352 14·80	0·354 15·60	0·356 16·40	0·358 17·20	0·360 18·00	0·361 18·80	0·363 19·59	0·364 20·38	0·365 21·17
0·1	0·465 13·95	0·469 15·04	0·473 16·13	0·477 17·22	0·481 18·31	0·485 19·40	0·488 20·50	0·491 21·60	0·493 22·70	0·496 23·80	0·498 24·90	0·500 26·00	0·502 27·10	0·504 28·20	0·505 29·29
0·2	0·650 19·50	0·657 21·01	0·663 22·52	0·668 24·04	0·673 25·56	0·677 27·08	0·681 28·61	0·685 30·14	0·688 31·66	0·691 33·18	0·694 34·70	0·696 36·22	0·699 37·74	0·701 39·26	0·703 40·77
0·3	0·790 23·70	0·798 25·54	0·805 27·38	0·812 29·22	0·818 31·07	0·823 32·92	0·827 34·76	0·831 36·60	0·835 38·45	0·839 40·30	0·843 42·15	0·846 44·01	0·850 45·88	0·853 47·76	0·856 49·64
0·4	0·912 27·36	0·921 29·48	0·929 31·61	0·937 33·74	0·945 35·87	0·950 38·00	0·955 40·13	0·960 42·26	0·965 44·39	0·969 46·52	0·973 48·65	0·976 50·78	0·980 52·91	0·983 55·05	0·986 57·19
0·5	1·018 30·54	1·028 32·89	1·037 35·24	1·045 37·60	1·052 39·96	1·058 42·32	1·064 44·69	1·070 47·06	1·075 49·44	1·080 51·82	1·084 54·20	1·088 56·58	1·092 58·96	1·[illegible]6 62·35	1·099 63·74
0·6	1·116 33·48	1·126 36·06	1·136 38·64	1·145 41·22	1·154 43·81	1·160 46·40	1·166 48·98	1·172 51·57	1·177 54·16	1·182 56·75	1·187 59·35	1·192 61·96	1·196 64·58	1·200 67·20	1·204 69·83
0·7	1·205 36·15	1·217 38·92	1·227 41·70	1·236 44·49	1·244 47·28	1·252 50·08	1·259 52·89	1·266 55·70	1·272 58·51	1·278 61·32	1·283 64·14	1·288 66·95	1·292 69·76	1·296 72·58	1·300 75·40
0·8	1·288 38·64	1·300 41·60	1·312 44·57	1·321 47·55	1·330 50·53	1·338 53·52	1·346 56·52	1·353 59·53	1·360 62·55	1·366 65·57	1·372 68·60	1·377 71·62	1·382 74·63	1·386 77·63	1·390 80·62

0·9	1·366 40·98	1·380 44·14	1·392 47·30	1·402 50·46	1·411 53·63	1·420 56·80	1·428 59·98	1·435 63·16	1·442 66·34	1·448 69·52	1·454 72·70	1·460 75·89	1·465 79·09	1·470 82·29	1·474 85·49
1·0	1·440 43·20	1·454 46·51	1·467 49·83	1·477 53·16	1·487 56·50	1·496 59·84	1·505 63·19	1·513 66·55	1·520 69·91	1·527 73·28	1·533 76·65	1·539 80·03	1·545 83·41	1·550 86·80	1·555 90·19
1·2	1·578 47·34	1·593 50·97	1·607 54·61	1·618 58·25	1·629 61·90	1·639 65·56	1·649 69·23	1·657 72·91	1·665 76·59	1·672 80·27	1·679 83·95	1·686 87·64	1·692 91·84	1·698 95·05	1·703 98·77
1·4	1·705 51·15	1·720 55·06	1·735 58·98	1·748 62·91	1·759 66·85	1·770 70·80	1·781 74·76	1·790 78·73	1·799 82·71	1·807 86·70	1·814 90·70	1·821 94·70	1·827 98·71	1·833 102·7	1·839 106·7
1·6	1·822 54·66	1·840 58·86	1·855 63·07	1·870 67·28	1·882 71·50	1·893 75·72	1·904 79·95	1·914 84·19	1·923 88·44	1·931 92·69	1·939 96·95	1·947 101·2	1·954 105·5	1·960 109·7	1·966 114·0
1·8	1·933 57·99	1·951 62·44	1·967 66·90	1·982 71·37	1·996 75·84	2·008 80·32	2·019 84·80	2·029 89·29	2·039 93·79	2·048 98·30	2·056 102·8	2·064 107·3	2·072 111·8	2·079 116·4	2·086 121·0
2·0	2·037 61·11	2·057 65·81	2·074 70·52	2·090 75·23	2·104 79·95	2·117 84·68	2·129 89·42	2·139 94·16	2·149 98·90	2·159 103·7	2·168 108·4	2·177 113·2	2·184 117·9	2·191 122·7	2·198 127·5
2·2	2·136 64·08	2·157 69·01	2·175 73·95	2·192 78·89	2·206 83·84	2·220 88·80	2·233 93·77	2·244 98·75	2·255 103·7	2·265 108·7	2·274 113·7	2·282 118·7	2·290 123·7	2·298 128·7	2·306 133·7
2·4	2·232 66·96	2·253 72·11	2·272 77·27	2·289 82·43	2·305 87·59	2·319 92·76	2·332 97·94	2·344 103·1	2·355 108·3	2·365 113·5	2·375 118·7	2·384 123·9	2·392 129·2	2·400 134·4	2·408 139·7
2·6	2·323 69·69	2·345 75·04	2·365 80·40	2·382 85·76	2·398 91·07	2·413 96·52	2·427 101·9	2·440 107·3	2·451 112·7	2·461 118·1	2·471 123·6	2·481 129·0	2·490 134·5	2·499 139·9	2·507 145·4
2·8	2·410 72·30	2·433 77·87	2·454 83·45	2·472 89·03	2·489 94·61	2·504 100·2	2·518 105·8	2·531 111·4	2·543 117·0	2·554 122·6	2·565 128·2	2·575 133·8	2·584 139·5	2·593 145·2	2·601 150·9
3·0	2·495 74·85	2·519 80·60	2·540 86·36	2·560 92·13	2·577 97·91	2·593 103·7	2·607 109·5	2·620 115·3	2·633 121·1	2·644 126·9	2·655 132·7	2·665 138·5	2·674 144·3	2·683 150·2	2·692 156·1

CLASS II. ($n = 0{\cdot}30$.)

Mean Velocities and Quantities of Discharge per second.

For 1 Depth of Water of 2·2.

For Bottom-Widths of

Fall per thousand.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0·05	0·368 15·62	0·371 16·57	0·374 17·52	0·377 18·47	0·379 19·42	0·381 20·36	0·383 21·30	0·385 22·24	0·386 23·18	0·388 24·13	0·389 25·08	0·390 26·02	0·392 26·97	0·393 27·92	0·394 28·87
0·1	0·509 21·61	0·513 22·90	0·517 24·19	0·520 25·48	0·522 26·77	0·525 28·07	0·527 29·36	0·529 30·65	0·531 31·95	0·534 33·15	0·536 34·55	0·538 35·85	0·540 37·16	0·542 38·47	0·543 39·78
0·2	0·709 30·10	0·714 31·89	0·719 33·68	0·723 35·47	0·727 37·27	0·731 39·07	0·734 40·87	0·737 42·67	0·740 44·47	0·743 46·27	0·746 48·07	0·748 49·86	0·750 51·65	0·752 53·44	0·754 55·24
0·3	0·861 36·56	0·868 38·74	0·874 40·92	0·879 43·10	0·884 45·28	0·888 47·47	0·892 49·66	0·896 51·85	0·899 54·04	0·903 56·22	0·906 58·40	0·909 60·58	0·912 62·76	0·914 64·94	0·916 67·12
0·4	0·994 42·21	1·002 44·72	1·009 47·24	1·015 49·76	1·020 52·28	1·025 54·80	1·030 57·32	1·034 59·84	1·038 62·36	1·042 64·89	1·046 67·42	1·049 69·94	1·052 72·46	1·055 74·99	1·058 77·52
0·5	1·107 47·00	1·115 49·78	1·122 52·57	1·129 55·36	1·135 58·15	1·140 60·94	1·145 63·73	1·150 66·52	1·154 69·31	1·158 72·10	1·162 74·90	1·166 77·69	1·169 80·48	1·172 83·28	1·175 86·08
0·6	1·213 51·50	1·221 54·55	1·229 57·60	1·236 60·65	1·243 63·71	1·249 66·77	1·254 69·82	1·259 72·88	1·264 75·94	1·269 79·00	1·273 82·06	1·277 85·11	1·281 88·17	1·284 91·23	1·287 94·29
0·7	1·311 55·67	1·320 58·96	1·328 62·25	1·336 65·54	1·343 68·83	1·349 72·12	1·355 75·42	1·361 78·72	1·366 82·02	1·371 85·32	1·375 88·62	1·379 91·91	1·383 95·20	1·387 98·50	1·390 101·8
0·8	1·401 59·48	1·410 63·00	1·419 66·52	1·427 70·04	1·435 73·56	1·442 77·09	1·448 80·62	1·454 84·15	1·460 87·68	1·465 91·22	1·470 94·76	1·474 98·29	1·478 101·8	1·482 105·3	1·486 108·9

0·9	1·486 63·10	1·496 66·81	1·506 70·53	1·514 74·26	1·522 78·00	1·529 81·74	1·536 85·49	1·542 89·24	1·548 92·99	1·554 96·74	1·559 100·5	1·564 104·2	1·569 107·9	1·573 111·7	1·577 115·5
1·0	1·567 66·53	1·577 70·46	1·587 74·39	1·596 78·32	1·605 82·25	1·612 86·18	1·619 90·12	1·626 94·06	1·632 98·00	1·638 101·9	1·643 105·9	1·648 109·8	1·653 113·7	1·658 117·7	1·662 121·7
1·2	1·716 72·86	1·727 77·17	1·738 81·48	1·748 85·79	1·758 90·10	1·766 94·41	1·774 98·72	1·781 103·0	1·788 107·3	1·794 111·6	1·800 116·0	1·806 120·3	1·811 124·6	1·816 128·9	1·820 133·3
1·4	1·854 78·72	1·866 83·37	1·878 88·02	1·889 92·68	1·899 97·34	1·908 102·0	1·916 106·6	1·924 111·2	1·931 115·9	1·938 120·6	1·944 125·3	1·950 129·9	1·956 134·6	1·961 139·3	1·966 144·0
1·6	1·982 84·16	1·995 89·14	2·007 94·13	2·019 99·12	2·030 104·1	2·039 109·1	2·048 114·0	2·057 119·0	2·065 124·0	2·072 129·0	2·079 134·0	2·085 139·0	2·091 144·0	2·097 149·0	2·102 154·0
1·8	2·102 89·25	2·116 94·51	2·129 99·78	2·141 105·1	2·153 110·3	2·163 115·6	2·172 120·9	2·181 126·2	2·190 131·5	2·198 136·8	2·205 142·1	2·212 147·4	2·218 152·7	2·224 158·0	2·230 163·4
2·0	2·215 94·04	2·230 99·61	2·244 105·2	2·257 110·7	2·270 116·3	2·280 121·9	2·290 127·4	2·299 133·0	2·308 138·6	2·316 144·2	2·324 149·8	2·331 155·3	2·338 160·9	2·344 166·5	2·350 172·1
2·2	2·323 98·63	2·338 104·5	2·353 110·3	2·367 116·1	2·381 122·0	2·392 127·9	2·402 133·7	2·411 139·5	2·420 145·4	2·429 151·3	2·437 157·2	2·445 163·0	2·452 168·8	2·459 174·7	2·465 180·6
2·4	2·427 103·0	2·444 109·1	2·459 115·2	2·473 121·3	2·486 127·4	2·497 133·5	2·508 139·6	2·518 145·7	2·528 151·8	2·537 157·9	2·546 164·1	2·554 170·2	2·561 176·3	2·568 182·4	2·574 188·6
2·6	2·526 107·2	2·543 113·5	2·559 119·8	2·574 126·2	2·588 132·6	2·600 139·0	2·611 145·3	2·622 151·6	2·632 158·0	2·641 164·4	2·650 170·8	2·658 177·1	2·665 183·5	2·672 189·9	2·679 196·3
2·8	2·621 111·3	2·639 117·8	2·655 124·4	2·670 131·0	2·685 137·6	2·697 144·2	2·709 150·8	2·720 157·4	2·731 164·0	2·741 170·6	2·750 177·2	2·758 183·8	2·766 190·4	2·773 197·0	2·780 203·6
3·0	2·713 115·2	2·732 122·0	2·750 128·8	2·765 135·6	2·780 142·4	2·792 149·3	2·804 156·1	2·816 162·9	2·827 169·7	2·837 176·5	2·846 183·4	2·855 190·2	2·863 197·1	2·871 204·0	2·878 210·9

CLASS II. ($n = 0{\cdot}30$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 2·4.

For Bottom-Widths of

Fall per thousand.	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
0·05	0·400 22·67	0·403 23·78	0·405 24·89	0·407 26·00	0·409 27·10	0·411 28·20	0·413 29·30	0·415 30·40	0·416 31·50	0·417 32·60	0·418 33·70	0·419 34·80	0·420 35·90	0·421 36·99	0·422 38·08
0·1	0·552 31·27	0·555 32·77	0·557 34·27	0·560 35·77	0·562 37·27	0·565 38·78	0·567 40·28	0·569 41·78	0·570 43·28	0·572 44·78	0·574 46·29	0·575 47·80	0·577 49·31	0·579 50·82	0·580 52·34
0·2	0·767 43·44	0·771 45·52	0·774 47·59	0·778 49·66	0·781 51·73	0·784 53·80	0·787 55·87	0·789 57·94	0·791 60·01	0·793 62·08	0·795 64·14	0·797 66·22	0·800 68·32	0·802 70·43	0·804 72·54
0·3	0·932 52·79	0·937 55·32	0·941 57·85	0·945 60·37	0·949 62·89	0·953 65·41	0·956 67·93	0·959 70·45	0·961 72·97	0·964 75·48	0·967 77·99	0·969 80·52	0·972 83·06	0·975 85·61	0·977 88·16
0·4	1·073 60·77	1·078 63·67	1·083 66·57	1·088 69·48	1·093 72·39	1·097 75·30	1·101 78·20	1·104 81·11	1·107 84·02	1·111 86·93	1·114 89·84	1·117 92·75	1·120 95·66	1·123 98·58	1·125 101·5
0·5	1·194 67·62	1·200 70·85	1·205 74·09	1·211 77·33	1·216 80·57	1·221 83·81	1·224 87·04	1·228 90·28	1·232 93·52	1·236 96·76	1·240 100·0	1·243 103·2	1·246 106·4	1·249 109·7	1·251 113·0
0·6	1·308 74·08	1·314 77·61	1·320 81·15	1·326 84·69	1·332 88·23	1·337 91·77	1·341 95·31	1·346 98·85	1·350 102·4	1·354 105·9	1·358 109·5	1·361 113·0	1·365 116·5	1·368 120·1	1·371 123·7
0·7	1·413 80·04	1·420 83·85	1·426 87·66	1·432 91·47	1·438 95·29	1·444 99·11	1·449 102·9	1·454 106·7	1·458 110·5	1·462 114·3	1·466 118·2	1·470 122·0	1·474 125·8	1·478 129·6	1·481 133·5
0·8	1·511 85·59	1·518 89·65	1·525 93·71	1·532 97·77	1·538 101·8	1·543 105·9	1·548 109·9	1·553 114·0	1·558 118·1	1·562 122·2	1·567 126·3	1·571 130·4	1·575 134·5	1·579 138·6	1·582 142·7

0·9	1·602 90·74	1·610 95·04	1·617 99·35	1·624 103·7	1·631 108·0	1·637 112·3	1·642 116·6	1·648 120·9	1·653 125·2	1·658 129·6	1·663 134·0	1·667 138·3	1·671 142·6	1·675 147·0	1·679 151·4
1·0	1·689 95·65	1·697 100·2	1·704 104·7	1·712 109·3	1·719 113·9	1·725 118·5	1·731 123·0	1·737 127·5	1·742 132·1	1·747 136·7	1·752 141·3	1·757 145·8	1·761 150·4	1·765 155·0	1·769 159·6
1·2	1·850 104·8	1·859 109·8	1·867 114·8	1·875 119·8	1·883 124·8	1·890 129·8	1·896 134·8	1·902 139·8	1·908 144·8	1·914 149·8	1·920 154·8	1·925 159·8	1·930 164·8	1·934 169·8	1·938 174·9
1·4	1·998 113·1	2·008 118·5	2·017 123·9	2·026 129·3	2·034 134·7	2·041 140·1	2·048 145·5	2·055 150·9	2·061 156·3	2·067 161·7	2·073 167·1	2·079 172·5	2·084 178·0	2·089 183·5	2·094 189·0
1·6	2·136 121·0	2·146 126·7	2·156 132·5	2·166 138·3	2·175 144·1	2·183 149·9	2·190 155·6	2·197 161·4	2·204 167·2	2·211 173·0	2·217 178·8	2·223 184·5	2·228 190·3	2·233 196·1	2·238 201·9
1·8	2·266 128·3	2·277 134·4	2·287 140·5	2·297 146·6	2·307 152·7	2·315 158·9	2·323 165·0	2·330 171·1	2·337 177·2	2·344 183·4	2·351 189·6	2·358 195·7	2·364 201·8	2·369 208·0	2·374 214·2
2·0	2·388 135·3	2·399 141·7	2·410 148·1	2·421 154·6	2·431 161·1	2·440 167·6	2·448 174·0	2·456 180·5	2·464 187·0	2·472 193·5	2·480 200·0	2·486 206·4	2·492 212·9	2·497 219·4	2·502 225·9
2·2	2·505 141·9	2·517 148·6	2·528 155·3	2·539 162·0	2·550 168·8	2·559 175·6	2·568 182·4	2·576 189·2	2·584 196·0	2·592 202·8	2·600 209·6	2·607 216·4	2·613 223·2	2·619 230·0	2·624 236·8
2·4	2·616 148·2	2·628 155·2	2·640 162·2	2·652 169·3	2·663 176·4	2·673 183·5	2·682 190·5	2·691 197·6	2·699 204·7	2·707 211·8	2·715 218·9	2·723 226·0	2·729 233·1	2·735 240·2	2·741 247·3
2·6	2·723 154·2	2·736 161·5	2·748 168·8	2·760 176·1	2·771 183·5	2·781 190·9	2·791 198·2	2·800 205·6	2·809 213·0	2·818 220·4	2·826 227·8	2·834 235·2	2·841 242·6	2·847 250·0	2·853 257·4
2·8	2·826 160·0	2·839 167·6	2·852 175·2	2·865 182·8	2·877 190·4	2·887 198·1	2·897 205·7	2·906 213·3	2·915 221·0	2·924 228·7	2·932 236·4	2·940 244·1	2·947 251·8	2·954 259·5	2·961 267·2
3·0	2·925 165·6	2·939 173·5	2·952 181·4	2·965 189·3	2·978 197·2	2·989 205·1	2·999 213·0	3·008 220·9	3·017 228·8	3·026 236·7	3·035 244·7	3·044 252·6	3·051 260·5	3·058 268·5	3·065 276·5

CLASS II. (n = 0·30.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 2·6.

For Bottom-Widths of

Fall per thousand.	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
0·05	0·436 33·89	0·438 35·17	0·439 36·45	0·441 37·73	0·442 39·01	0·444 40·29	0·445 41·57	0·447 42·85	0·448 44·13	0·449 45·41	0·450 46·69	0·450 47·94	0·451 49·17	0·452 50·40	0·452 51·61
0·1	0·596 46·33	0·598 48·03	0·600 49·74	0·602 51·55	0·603 53·27	0·605 54·90	0·607 56·64	0·609 58·40	0·610 60·17	0·612 61·93	0·614 63·69	0·615 65·44	0·617 67·18	0·618 68·92	0·619 70·65
0·2	0·826 64·21	0·829 66·57	0·831 68·93	0·833 71·29	0·835 73·66	0·838 76·03	0·840 78·41	0·842 80·80	0·844 83·19	0·846 85·58	0·848 87·96	0·850 90·32	0·851 92·67	0·852 95·02	0·853 97·36
0·3	1·004 78·05	1·007 80·88	1·010 83·72	1·013 86·57	1·015 89·42	1·017 92·28	1·019 95·15	1·021 98·03	1·023 100·9	1·026 103·8	1·029 106·7	1·032 109·6	1·034 112·5	1·036 115·4	1·037 118·3
0·4	1·156 89·87	1·159 93·15	1·161 96·43	1·165 99·72	1·169 103·0	1·172 106·3	1·175 109·6	1·178 112·9	1·181 116·2	1·183 119·5	1·185 122·9	1·187 126·2	1·190 129·6	1·193 133·0	1·195 136·4
0·5	1·286 99·98	1·290 103·6	1·294 107·8	1·298 111·0	1·301 114·7	1·304 118·3	1·307 122·0	1·309 125·6	1·311 129·2	1·314 132·9	1·317 136·6	1·320 140·3	1·322 144·0	1·325 147·7	1·327 151·4
0·6	1·405 109·2	1·409 113·2	1·413 117·2	1·417 121·2	1·421 125·2	1·425 129·3	1·428 133·3	1·432 137·3	1·435 141·3	1·438 145·4	1·441 149·5	1·444 153·5	1·447 157·5	1·450 161·6	1·452 165·7
0·7	1·517 117·9	1·521 122·2	1·525 126·5	1·530 130·8	1·534 135·2	1·539 139·6	1·543 143·9	1·547 148·2	1·551 152·6	1·554 157·0	1·556 161·4	1·558 165·7	1·561 170·0	1·564 174·4	1·567 178·8
0·8	1·618 [illegible]	1·625 [illegible]	1·631 [illegible]	1·636 [illegible]	1·641 [illegible]	1·645 [illegible]	1·649 [illegible]	1·653 [illegible]	1·657 [illegible]	1·661 [illegible]	1·664 [illegible]	1·667 [illegible]	1·670 [illegible]	1·673 [illegible]	1·676 [illegible]

0·9	1·720 133·7	1·726 138·6	1·731 143·5	1·736 148·4	1·741 153·3	1·745 158·3	1·749 163·2	1·754 168·1	1·758 173·1	1·762 178·1	1·765 183·1	1·768 188·0	1·771 192·2	1·774 197·8	1·777 202·8
1·0	1·813 140·9	1·819 146·1	1·825 151·3	1·830 156·5	1·835 161·7	1·840 166·9	1·844 172·1	1·849 177·3	1·853 182·5	1·857 187·7	1·861 193·0	1·864 198·2	1·867 203·4	1·870 208·6	1·873 213·8
1·2	1·986 154·4	1·993 160·0	1·999 165·7	2·005 171·4	2·010 177·1	2·015 182·8	2·020 188·5	2·025 194·2	2·030 199·9	2·034 205·6	2·038 211·4	2·042 217·1	2·046 222·8	2·049 228·5	2·052 234·2
1·4	2·145 166·7	2·152 172·8	2·159 178·9	2·165 185·1	2·171 191·3	2·177 197·5	2·182 203·6	2·187 209·7	2·192 215·9	2·197 222·1	2·201 228·3	2·205 234·4	2·209 240·6	2·213 246·8	2·217 253·0
1·6	2·293 178·2	2·301 184·7	2·308 191·3	2·315 197·9	2·321 204·5	2·327 211·1	2·332 217·7	2·338 224·3	2·344 230·9	2·349 237·5	2·353 244·1	2·357 250·6	2·361 257·2	2·365 263·8	2·369 270·4
1·8	2·432 189·0	2·440 195·9	2·448 202·9	2·455 209·9	2·462 216·9	2·468 223·9	2·474 230·9	2·480 237·9	2·486 244·9	2·491 251·9	2·496 258·9	2·560 265·8	2·505 272·8	2·509 279·8	2·513 286·8
2·0	2·564 199·3	2·572 206·6	2·580 213·9	2·588 221·3	2·595 228·7	2·602 236·1	2·608 243·4	2·614 250·8	2·620 258·2	2·626 265·6	2·631 273·0	2·636 280·3	2·641 287·6	2·645 294·9	2·649 302·3
2·2	2·689 209·0	2·698 216·7	2·706 224·4	2·714 232·1	2·721 239·8	2·728 247·5	2·735 255·3	2·742 263·1	2·748 270·8	2·754 278·5	2·759 286·2	2·764 294·0	2·769 301·7	2·774 309·4	2·778 317·1
2·4	2·809 218·4	2·818 226·4	2·827 234·4	2·835 242·4	2·842 250·5	2·850 258·6	2·857 266·6	2·864 274·6	2·870 282·7	2·876 290·8	2·882 298·9	2·887 306·9	2·892 315·0	2·897 323·1	2·902 331·2
2·6	2·923 227·2	2·933 235·6	2·942 244·0	2·950 252·4	2·958 260·8	2·966 269·2	2·973 277·6	2·981 286·0	2·988 294·4	2·994 302·8	3·000 311·2	3·005 319·6	3·011 328·0	3·016 336·4	3·021 344·8
2·8	3·034 235·9	3·044 244·5	3·054 253·2	3·062 261·9	3·070 270·6	3·078 279·3	3·085 288·0	3·093 296·7	3·100 305·4	3·106 314·1	3·112 322·8	3·118 331·5	3·124 340·2	3·130 349·0	3·135 357·8
3·0	3·141 244·2	3·151 253·1	3·160 262·1	3·169 271·1	3·178 280·1	3·186 289·1	3·194 298·1	3·202 307·1	3·209 316·1	3·216 325·2	3·223 334·3	3·229 343·3	3·235 352·3	3·240 361·3	3·245 370·4

CLASS II. (n = 0·030.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 2·8.

For Bottom-Widths of

Fall per thousand.	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
0·05	0·470 50·27	0·471 51·73	0·472 53·19	0·473 54·65	0·475 56·11	0·476 57·57	0·477 59·03	0·478 60·49	0·479 61·96	0·480 63·43	0·481 64·90	0·482 66·37	0·482 67·83	0·483 69·29	0·484 70·75
0·1	0·640 68·45	0·642 70·40	0·643 72·36	0·644 74·32	0·646 76·28	0·647 78·25	0·648 80·22	0·650 82·19	0·651 84·17	0·652 86·15	0·653 88·13	0·654 90·10	0·655 92·08	0·656 94·05	0·657 96·03
0·2	0·883 94·45	0·885 97·14	0·887 99·83	0·888 102·5	0·890 105·2	0·892 107·9	0·894 110·5	0·896 113·2	0·898 115·9	0·899 118·6	0·900 121·3	0·901 124·0	0·902 126·7	0·903 129·4	0·904 132·1
0·3	1·073 114·7	1·075 117·9	1·077 121·1	1·079 124·4	1·081 127·7	1·083 131·0	1·085 134·2	1·087 137·5	1·089 140·8	1·091 144·1	1·093 147·4	1·095 150·7	1·096 154·0	1·098 157·3	1·099 160·6
0·4	1·233 131·9	1·236 135·6	1·239 139·3	1·241 143·1	1·244 146·9	1·246 150·7	1·248 154·4	1·250 158·1	1·252 161·9	1·254 165·7	1·256 169·5	1·258 173·3	1·260 177·1	1·262 180·9	1·264 184·7
0·5	1·375 147·0	1·378 151·2	1·381 155·4	1·383 159·6	1·386 163·8	1·389 168·0	1·391 172·2	1·394 176·4	1·396 180·6	1·398 184·8	1·400 189·0	1·403 193·2	1·405 197·4	1·407 201·6	1·409 205·9
0·6	1·499 160·3	1·502 164·8	1·505 169·4	1·508 174·0	1·511 178·6	1·514 183·2	1·517 187·8	1·520 192·4	1·523 197·0	1·526 201·6	1·529 206·2	1·531 210·8	1·533 215·4	1·535 220·0	1·537 224·6
0·7	1·618 173·0	1·621 177·9	1·624 182·8	1·627 187·7	1·631 192·7	1·634 197·7	1·637 202·6	1·641 207·6	1·644 212·6	1·647 217·6	1·650 222·6	1·653 227·6	1·655 232·6	1·657 237·6	1·660 242·6
0·8	1·730 185·0	1·734 190·2	1·738 195·5	1·741 200·8	1·745 206·1	1·748 211·4	1·751 216·6	1·754 221·9	1·757 227·2	1·760 232·5	1·763 237·8	1·765 243·0	1·767 248·3	1·769 253·6	1·771 258·9

0·9	1·834 196·1	1·838 201·7	1·842 207·3	1·846 212·9	1·850 218·5	1·854 224·2	1·857 229·8	1·860 235·4	1·863 241·0	1·866 246·6	1·869 252·2	1·872 257·8	1·874 263·4	1·876 269·0	1·878 274·5
1·0	1·933 206·7	1·938 212·6	1·942 218·5	1·946 224·4	1·950 230·3	1·954 236·3	1·957 242·2	1·961 248·1	1·964 254·0	1·967 259·9	1·970 265·9	1·973 271·8	1·975 277·7	1·978 283·6	1·980 289·5
1·2	2·118 226·5	2·123 232·9	2·128 239·3	2·132 245·8	2·136 252·3	2·140 258·8	2·143 265·2	2·147 271·7	2·151 278·2	2·155 284·7	2·158 291·2	2·161 297·6	2·164 304·1	2·167 310·6	2·170 317·1
1·4	2·288 244·7	2·293 251·6	2·298 258·5	2·302 265·5	2·307 272·5	2·311 279·5	2·315 286·5	2·320 293·5	2·324 300·5	2·328 307·5	2·331 314·5	2·334 321·5	2·337 328·5	2·340 335·5	2·343 342·5
1·6	2·446 261·6	2·452 269·0	2·457 276·4	2·462 283·9	2·467 291·4	2·471 298·9	2·475 306·3	2·480 313·8	2·484 321·3	2·488 328·8	2·492 336·3	2·496 343·7	2·499 351·2	2·502 358·7	2·505 366·2
1·8	2·594 277·5	2·600 285·4	2·606 293·3	2·612 301·2	2·617 309·1	2·622 317·1	2·626 325·0	2·631 332·9	2·635 340·8	2·639 348·7	2·643 356·7	2·647 364·6	2·650 372·5	2·653 380·4	2·656 388·3
2·0	2·734 292·4	2·740 300·7	2·746 309·0	2·752 317·4	2·757 325·8	2·762 334·2	2·767 342·5	2·772 350·8	2·777 359·2	2·782 367·6	2·786 376·0	2·790 384·3	2·793 392·7	2·796 401·0	2·800 409·4
2·2	2·868 306·8	2·875 315·5	2·881 324·2	2·887 333·0	2·893 341·8	2·898 350·6	2·903 359·3	2·908 368·0	2·913 376·8	2·918 385·6	2·922 394·4	2·926 403·1	2·930 411·9	2·934 420·6	2·938 429·4
2·4	2·996 320·5	3·003 329·6	3·009 338·7	3·015 347·8	3·021 356·9	3·026 366·1	3·031 375·2	3·037 384·3	3·042 393·4	3·047 402·6	3·052 411·8	3·056 420·9	3·060 430·1	3·064 439·2	3·068 448·4
2·6	3·117 333·4	3·124 342·9	3·131 352·4	3·138 361·9	3·144 371·4	3·150 381·0	3·155 390·5	3·161 400·0	3·167 409·5	3·172 419·1	3·177 428·7	3·181 438·2	3·185 447·8	3·189 457·4	3·193 467·0

CLASS II. ($n = 0·030$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 3·0.

For Bottom-Widths of

Fall per thousand.	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
0·05	0·486	0·487	0·488	0·489	0·490	0·492	0·493	0·494	0·495	0·496	0 497	0·498	0·499	0·500	0·501
	62·69	64·32	65·95	67·58	69·21	70·84	72·48	74·12	75·76	77·39	79·02	80·64	82·25	83·86	85·47
0·1	0·660	0·662	0·663	0·664	0·666	0·667	0·668	0·670	0·671	0·672	0·674	0·675	0·676	0·677	0·678
	85·13	87·31	89·49	91·67	93·86	96·05	98·25	100·4	102·7	104·9	107·1	109·3	111·5	113·7	115·8
0·2	0·908	0·911	0·913	0·915	0·917	0·919	0·920	0·922	0·924	0·925	0·927	0·929	0·930	0·932	0·933
	117·1	120·1	123·1	126·1	129·2	132·3	135·3	138·3	141·3	144·4	147·5	150·5	153·4	156·3	159·2
0·3	1·103	1·106	1·108	1·110	1·113	1·115	1·117	1·119	1·121	1·123	1·125	1·127	1·128	1·130	1·132
	142·3	145·9	149·5	153·1	156·8	160·5	164·2	167·9	171·6	175·2	178·8	182·4	186·0	189·6	193·2
0·4	1·267	1·270	1·273	1·275	1·278	1·281	1·283	1·286	1·288	1·290	1·292	1·294	1·296	1·298	1·300
	163·4	167·6	171·8	176·0	180·2	184·4	188·6	192·8	197·0	201·2	205·4	209·5	213·6	217·7	221·8
0·5	1·413	1·417	1·420	1·423	1·426	1·429	1·431	1·434	1·437	1·439	1·441	1·443	1·445	1·447	1·449
	182·3	187·0	191·7	196·4	201·1	205·7	210·4	215·1	219·8	224·5	229·1	233·7	238·3	242·8	247·3
0·6	1·540	1·544	1·547	1·550	1·553	1·556	1·559	1·562	1·565	1·568	1·571	1·574	1·576	1·579	1·581
	198·6	203·8	208·9	214·0	219·1	224·2	229·4	234·5	239·6	244·7	249·8	254·8	259·8	264·8	269·8
0·7	1·663	1·667	1·671	1·675	1·679	1·682	1·685	1·688	1·691	1·694	1·697	1·699	1·701	1·704	1·707
	214·6	220·2	225·7	231·2	236·7	242·2	247·8	253·3	258·8	264·3	269·8	275·2	280·6	285·9	291·2
0·8	1·778	1·782	1·786	1·790	1·794	1·798	1·801	1·805	1·808	1·811	1·814	1·817	1·819	1·822	1·824
	229·8	235·3	241·2	247·1	253·0	258·9	264·8	270·7	276·6	282·5	288·4	294·2	299·9	305·6	311·2

0·9	1·886 243·3	1·891 249·6	1·895 255·9	1·899 262·2	1·903 268·4	1·907 274·6	1·910 280·9	1·914 287·2	1·918 293·5	1·921 299·7	1·924 305·9	1·927 312·0	1·929 318·0	1·932 324·0	1·934 330·0
1·0	1·988 256·4	1·993 263·1	1·998 269·7	2·002 276·3	2·006 282·9	2·010 289·5	2·014 296·1	2·018 302·7	2·021 309·3	2·024 315·9	2·028 322·5	2·031 329·0	2·034 335·4	2·037 341·8	2·040 348·1
1·2	2·178 280·9	2·183 288·2	2·188 295·4	2·192 302·6	2·197 309·8	2·201 317·0	2·205 324·3	2·210 331·6	2·214 338·8	2·218 346·0	2·222 353·2	2·225 360·2	2·228 367·3	2·231 374·3	2·234 381·2
1·4	2·352 303·4	2·357 311·2	2·362 319·0	2·367 326·8	2·372 334·6	2·377 342·4	2·382 350·2	2·387 358·0	2·391 365·8	2·395 373·6	2·399 381·4	2·403 389·1	2·406 396·7	2·410 404·3	2·413 411·8
1·6	2·515 324·4	2·521 332·8	2·527 341·1	2·532 349·4	2·537 357·7	2·542 366·0	2·547 374·4	2·552 382·8	2·557 391·1	2·561 399·4	2·565 407·7	2·569 415·9	2·572 424·0	2·576 432·1	2·580 440·1
1·8	2·668 344·2	2·674 353·0	2·680 361·8	2·685 370·6	2·691 379·4	2·696 388·2	2·701 397·1	2·706 406·0	2·711 414·8	2·716 423·6	2·720 432·4	2·724 441·1	2·728 449·7	2·732 458·3	2·736 466·8
2·0	2·811 362·6	2·818 372·0	2·824 381·4	2·830 390·7	2·836 400·0	2·842 409·3	2·847 418·7	2·853 428·1	2·858 437·4	2·863 446·7	2·868 456·0	2·872 465·1	2·876 474·1	2·880 483·1	2·884 492·0
2·2	2·949 380·4	2·956 390·2	2·963 400·0	2·969 409·8	2·975 419·6	2·981 429·3	2·987 439·1	2·993 448·9	2·998 458·7	3·003 468·5	3·008 478·2	3·012 487·7	3·016 497·1	3·020 506·5	3·024 515·9

CLASS II. ($n = 0 \cdot 030$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 3·5.

For Bottom-Widths of

Fall per thousand.	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72
0·05	0·557 96·00	0·559 100·3	0·561 104·6	0·563 108·9	0·565 113·2	0·567 117·5	0·568 121·8	0·570 126·1	0·571 130·4	0·572 134·7	0·573 138·9	0·574 143·2	0·575 147·5	0·576 151·8	0·577 156·0
0·1	0·752 129·6	0·755 135·4	0·758 141·2	0·760 147·0	0·762 152·7	0·764 158·4	0·766 164·2	0·768 170·0	0·770 175·8	0·771 181·6	0·773 187·3	0·774 193·1	0·775 198·8	0·776 204·5	0·777 210·2
0·2	1·029 177·4	1·033 185·3	1·036 193·2	1·039 201·1	1·042 208·9	1·045 216·7	1·048 224·6	1·051 232·5	1·053 240·4	1·055 248·3	1·057 256·1	1·059 263·9	1·060 271·7	1·061 279·4	1·062 287·1
0·3	1·248 215·1	1·252 224·6	1·256 234·1	1·259 243·6	1·263 253·1	1·266 262·6	1·269 272·2	1·272 281·7	1·275 291·2	1·277 300·7	1·280 310·2	1·282 319·8	1·284 329·3	1·286 338·8	1·288 348·3
0·4	1·434 247·2	1·439 258·2	1·443 269·1	1·447 280·0	1·451 290·9	1·455 301·8	1·458 312·8	1·462 323·8	1·465 334·7	1·468 345·6	1·471 356·5	1·473 367·4	1·475 378·3	1·477 389·1	1·479 399·9
0·5	1·591 274·2	1·597 286·4	1·602 298·6	1·607 310·7	1·611 322·8	1·615 334·9	1·619 347·1	1·623 359·2	1·626 371·3	1·629 383·4	1·632 395·5	1·635 407·6	1·637 419·7	1·639 431·7	1·641 443·7
0·6	1·739 299·8	1·745 313·0	1·750 326·2	1·755 339·4	1·760 352·7	1·765 366·0	1·769 379·2	1·773 392·5	1·777 405·8	1·780 419·1	1·784 432·4	1·787 445·7	1·790 459·0	1·793 472·3	1·796 485·6
0·7	1·874 323·0	1·880 337·2	1·886 351·4	1·891 365·7	1·896 380·0	1·901 394·3	1·906 408·6	1·910 422·9	1·914 437·2	1·918 451·5	1·922 465·8	1·925 480·1	1·928 494·4	1·931 508·7	1·934 522·9
0·8	1·998 344·4	2·004 359·7	2·010 375·0	2·016 390·2	2·022 405·4	2·028 420·6	2·033 435·9	2·038 451·2	2·043 466·4	2·047 481·6	2·050 496·8	2·053 512·0	2·056 527·2	2·059 542·4	2·062 557·5

0·9	2·114 364·5	2·121 380·6	2·128 396·7	2·134 412·8	2·140 428·9	2·146 445·0	2·151 461·1	2·156 477·2	2·160 493·3	2·164 509·4	2·168 525·5	2·172 541·7	2·176 557·9	2·180 574·1	2·184 590·4
1·0	2·229 384·2	2·236 401·1	2·243 418·0	2·250 435·0	2·256 452·0	2·262 469·0	2·267 485·9	2·272 502·8	2·277 519·8	2·281 536·8	2·285 553·8	2·289 570·8	2·293 587·8	2·297 604·8	2·300 621·9
1·2	2·442 420·9	2·450 439·4	2·457 457·9	2·464 476·5	2·471 495·1	2·477 513·7	2·483 532·2	2·488 550·8	2·493 569·4	2·498 588·0	2·503 606·6	2·508 625·2	2·512 643·8	2·516 662·5	2·520 681·2
1·4	2·637 454·6	2·646 474·6	2·654 494·7	2·662 514·8	2·669 534·9	2·676 555·0	2·682 575·0	2·688 595·1	2·693 615·2	2·698 635·3	2·704 655·4	2·709 675·6	2·714 695·8	2·719 716·1	2·724 736·4
1·6	2·819 486·0	2·828 507·4	2·837 528·8	2·846 550·2	2·853 571·7	2·860 593·2	2·867 614·6	2·873 636·0	2·879 657·5	2·885 679·0	2·890 700·5	2·895 722·0	2·900 743·5	2·905 765·1	2·910 786·7
1·8	2·990 515·4	3·000 538·1	3·009 560·8	3·018 583·6	3·026 606·4	3·034 629·2	3·041 651·9	3·048 674·6	3·054 697·4	3·060 720·2	3·066 743·0	3·072 765·8	3·077 788·7	3·082 811·6	3·087 834·5
2·0	3·152 543·3	3·162 567·3	3·172 591·3	3·181 615·3	3·190 639·3	3·199 663·3	3·207 687·2	3·213 711·2	3·219 735·2	3·225 759·2	3·231 783·2	3·237 807·2	3·243 831·2	3·248 855·3	3·253 879·4

CLASS II. (n = 0·030.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 4·0.

For Bottom-Widths of

Fall per thousand.	47	50	53	56	59	62	65	68	71	74	77	80	83	86	89
0·05	0·611 129·5	0·614 137·7	0·617 145·8	0·620 153·9	0·623 162·0	0·625 170·1	0·627 178·3	0·629 186·5	0·631 194·6	0·633 202·7	0·635 210·8	0·636 218·8	0·637 226·8	0·638 234·8	0·639 242·8
0·1	0·819 173·6	0·823 184·4	0·827 195·2	0·831 206·0	0·834 216·8	0·837 227·7	0·840 238·5	0·843 249·3	0·845 260·1	0·847 270·9	0·849 281·8	0·851 292·7	0·853 303·7	0·855 314·7	0·857 325·7
0·2	1·121 237·6	1·126 252·3	1·131 267·0	1·136 281·7	1·140 296·5	1·144 311·3	1·148 326·0	1·151 340·8	1·154 355·6	1·157 370·4	1·160 385·1	1·163 399·9	1·165 414·7	1·167 429·5	1·169 444·2
0·3	1·354 287·0	1·360 304·7	1·366 322·4	1·371 340·2	1·376 358·0	1·381 375·8	1·386 393·6	1·390 411·4	1·394 429·2	1·397 447·0	1·400 464·8	1·403 482·7	1·406 500·6	1·409 518·5	1·412 536·5
0·4	1·555 329·6	1·562 350·0	1·569 370·5	1·576 391·0	1·582 411·5	1·588 432·0	1·593 452·5	1·598 473·0	1·602 493·5	1·606 514·0	1·610 534·6	1·614 555·1	1·617 575·6	1·620 596·1	1·623 616·7
0·5	1·726 365·8	1·734 388·5	1·742 411·2	1·750 433·9	1·756 456·6	1·762 479·4	1·768 502·2	1·773 525·0	1·778 547·8	1·782 570·6	1·787 593·4	1·791 616·3	1·795 639·2	1·799 662·1	1·803 685·1
0·6	1·887 400·0	1·896 424·7	1·905 449·5	1·913 474·3	1·920 499·1	1·926 523·9	1·932 548·7	1·938 573·5	1·943 598·3	1·948 623·1	1·952 648·0	1·956 672·8	1·960 697·7	1·964 722·6	1·967 747·5
0·7	2·033 431·0	2·043 457·8	2·052 484·6	2·061 511·3	2·069 538·0	2·076 564·7	2·086 591·5	2·088 618·3	2·094 645·1	2·099 671·8	2·104 698·5	2·108 725·2	2·112 751·9	2·116 778·6	2·119 805·2
0·8	2·168 459·6	2·179 488·1	2·189 516·6	2·198 545·1	2·206 573·6	2·214 602·2	2·221 630·7	2·227 659·2	2·233 687·7	2·238 716·2	2·243 744·7	2·248 773·2	2·252 801·7	2·256 830·2	2·260 858·8

0·9	2·294 486·3	2·305 516·4	2·315 546·5	2·325 576·7	2·334 606·9	2·342 637·1	2·350 667·3	2·357 697·5	2·363 727·7	2·369 757·9	2·374 788·1	2·379 818·2	2·383 848·3	2·387 878·5	2·391 908·7
1·0	2·418 512·6	2·430 544·4	2·441 576·2	2·451 608·0	2·460 639·8	2·469 671·6	2·477 703·4	2·484 735·2	2·491 767·0	2·497 799·8	2·502 830·6	2·507 862·4	2·512 894·2	2·516 925·9	2·520 957·6
1·2	2·649 561·6	2·662 596·4	2·674 631·2	2·685 666·0	2·695 700·8	2·704 735·6	2·713 770·4	2·721 805·2	2·728 840·1	2·735 875·0	2·741 909·9	2·747 945·4	2·752 980·9	2·767 1016	2·772 1052
1·4	2·862 606·7	2·876 644·2	2·889 681·8	2·900 719·4	2·911 757·0	2·921 794·6	2·931 832·2	2·940 869·8	2·948 907·4	2·954 945·0	2·960 982·7	2·966 1020	2·972 1058	2·977 1095	2·982 1133
1·6	3·059 648·5	3·074 688·7	3·088 728·9	3·100 769·1	3·112 809·3	3·123 849·5	3·134 889·8	3·143 930·1	3·151 970·4	3·158 1010	3·165 1051	3·172 1091	3·178 1131	3·184 1171	3·190 1212
1·8	3·245 688·2	3·261 731·4	3·276 774·5	3·289 817·6	3·301 860·7	3·313 903·8	3·324 946·3	3·334 988·8	3·342 1031	3·350 1073	3·357 1116	3·364 1158	3·371 1200	3·377 1243	3·383 1286
2·0	3·420 725·1	3·437 770·1	3·453 815·1	3·467 860·1	3·480 905·1	3·493 950·2	3·504 995·2	3·514 1040	3·523 1085	3·531 1130	3·538 1175	3·545 1220	3·552 1265	3·558 1310	3·564 1354

CLASS II. (n = 0·030.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 4·5.

For Bottom-Widths of

Fall per thousand.	50	54	58	62	66	70	74	78	82	86	90	94	98	102	106
0·02	0·464 118·5	0·468 127·9	0·471 137·3	0·474 146·7	0·477 156·1	0·479 165·5	0·481 174·9	0·483 184·3	0·485 193·7	0·486 203·1	0·488 212·5	0·489 221·8	0·490 231·1	0·491 240·4	0·492 249·7
0·03	0·543 138·7	0·547 149·5	0·550 160·4	0·553 171·3	0·556 182·2	0·559 193·1	0·561 204·0	0·563 214·9	0·565 225·8	0·567 236·7	0·569 247·6	0·570 258·4	0·571 269·2	0·572 280·0	0·573 290·8
0·05	0·663 169·3	0·667 182·5	0·671 195·7	0·675 208·9	0·678 222·1	0·681 235·3	0·684 248·5	0·687 261·7	0·689 275·0	0·691 288·3	0·693 301·6	0·695 314·8	0·696 328·1	0·698 341·4	0·699 354·7
0·07	0·761 194·3	0·766 209·4	0·771 224·5	0·775 239·7	0·779 254·9	0·782 270·1	0·785 285·3	0·788 300·5	0·791 315·7	0·793 330·9	0·795 346·1	0·797 361·3	0·799 376·5	0·800 391·7	0·802 406·9
0·1	0·885 226·0	0·890 243·5	0·895 261·0	0·900 278·5	0·904 296·1	0·908 313·7	0·912 331·2	0·915 348·7	0·918 366·2	0·920 383·8	0·922 401·4	0·925 419·1	0·927 436·9	0·929 454·6	0·931 472·4
0·2	1·205 307·8	1·212 331·7	1·219 355·6	1·226 379·5	1·232 403·3	1·237 427·1	1·241 451·0	1·245 474·9	1·249 498·8	1·252 522·6	1·255 546·4	1·258 570·2	1·260 594·0	1·262 617·7	1·264 641·4
0·3	1·458 372·3	1·466 400·9	1·474 429·6	1·481 458·3	1·487 487·0	1·493 515·7	1·498 544·5	1·503 573·3	1·508 602·2	1·512 631·1	1·516 660·0	1·519 688·8	1·522 717·6	1·525 746·4	1·528 775·2
0·4	1·671 426·6	1·681 459·5	1·690 492·4	1·698 525·4	1·705 558·4	1·712 591·4	1·718 624·4	1·724 657·4	1·729 690·4	1·734 723·5	1·738 756·6	1·742 789·9	1·746 823·2	1·750 856·5	1·754 889·8
0·5	1·856 473·9	1·866 510·4	1·876 546·9	1·885 583·4	1·893 620·0	1·901 656·6	1·908 693·3	1·914 730·0	1·920 766·7	1·925 803·4	1·930 840·2	1·934 877·0	1·938 913·8	1·942 950·6	1·946 987·4

0·6	2·018 515·3	2·030 555·0	2·041 594·8	2·051 634·6	2·060 674·4	2·068 714·2	2·075 754·0	2·081 793·8	2·087 833·7	2·093 873·6	2·098 913·5	2·103 953·6	2·108 993·7	2·113 1034	2·118 1074
0·7	2·180 556·7	2·192 599·5	2·204 642·3	2·215 685·1	2·224 728·0	2·232 770·9	2·240 813·8	2·247 856·7	2·254 899·6	2·260 942·5	2·265 985·4	2·269 1028	2·272 1071	2·275 1114	2·278 1157
0·8	2·330 595·0	2·342 640·4	2·352 685·8	2·362 731·3	2·372 776·8	2·381 822·3	2·390 868·4	2·398 914·5	2·405 960·6	2·412 1007	2·418 1053	2·424 1099	2·429 1145	2·434 1191	2·439 1237
0·9	2·460 628·2	2·475 676·6	2·488 725·0	2·500 773·4	2·510 821·9	2·520 870·4	2·529 919·1	2·537 967·8	2·545 1016	2·553 1065	2·559 1114	2·565 1162	2·570 1211	2·575 1260	2·580 1309
1·0	2·592 661·9	2·607 712·9	2·621 764·0	2·635 815·1	2·646 866·2	2·656 917·3	2·666 968·5	2·675 1020	2·683 1071	2·690 1122	2·697 1174	2·704 1225	2·710 1277	2·716 1329	2·722 1381
1·2	2·840 725·3	2·857 781·2	2·873 837·1	2·887 893·0	2·900 949·0	2·911 1005	2·921 1061	2·930 1117	2·939 1173	2·947 1239	2·954 1286	2·961 1342	2·968 1399	2·975 1456	2·982 1513
1·4	3·068 783·4	3·086 843·7	3·103 904·0	3·118 964·3	3·131 1024	3·143 1085	3·155 1146	3·165 1207	3·175 1268	3·184 1329	3·192 1390	3·199 1451	3·206 1512	3·213 1573	3·220 1634

CLASS II. ($n = 0 \cdot 030$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 5·0.

For Bottom-Widths of

Fall per thousand.	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150
0·02	0·505	0·509	0·513	0·517	0·520	0·523	0·525	0·527	0·529	0·531	0·533	0·535	0·536	0·538	0·539	0·540	0·541	0·542	0·542	0·543
	157·8	172·0	186·2	200·4	214·6	228·8	243·0	257·2	271·4	285·6	299·8	314·0	328·2	342·5	356·8	371·1	385·3	399·5	413·7	427·8
0·03	0·589	0·594	0·598	0·602	0·605	0·608	0·610	0·613	0·615	0·617	0·619	0·621	0·622	0·624	0·625	0·626	0·628	0·629	0·630	0·631
	184·1	200·4	216·8	233·2	249·6	266·0	282·4	298·8	315·2	331·6	348·1	364·5	380·9	397·3	418·8	430·3	446·9	463·5	480·2	496·9
0·05	0·714	0·719	0·724	0·729	0·733	0·737	0·740	0·743	0·746	0·748	0·750	0·752	0·753	0·755	0·757	0·758	0·760	0·761	0·762	0·763
	223·1	242·9	262·7	282·6	302·5	322·4	342·2	362·1	382·0	401·9	421·8	441·6	461·5	481·4	501·3	521·2	541·1	561·0	580·9	600·9
0·07	0·820	0·826	0·831	0·836	0·840	0·844	0·847	0·850	0·853	0·856	0·858	0·860	0·862	0·864	0·866	0·867	0·869	0·870	0·871	0·872
	256·3	278·8	301·4	324·0	346·6	369·2	391·8	414·5	437·2	459·9	482·6	505·2	527·9	550·6	573·3	596·0	618·7	641·4	664·1	686·8
0·1	0·951	0·957	0·963	0·969	0·974	0·979	0·983	0·986	0·989	0·992	0·995	0·998	1·000	1·002	1·004	1·006	1·008	1·009	1·010	1·011
	297·2	323·4	349·6	375·8	402·0	428·3	454·5	480·7	507·0	533·3	559·6	586·0	612·4	638·8	665·2	691·6	717·9	744·1	770·2	796·3
0·2	1·291	1·299	1·307	1·314	1·320	1·326	1·332	1·337	1·341	1·345	1·348	1·351	1·354	1·357	1·359	1·362	1·364	1·366	1·368	1·370
	403·5	438·8	474·1	509·4	544·7	580·0	615·6	651·2	686·8	722·5	758·2	793·8	829·4	865·0	900·6	936·3	971·9	1008	1043	1079
0·3	1·560	1·567	1·573	1·588	1·592	1·596	1·610	1·614	1·618	1·622	1·626	1·630	1·634	1·638	1·642	1·645	1·648	1·651	1·653	1·655
	487·5	529·3	571·4	613·5	655·6	698·2	741·4	784·6	827·9	871·2	914·5	957·8	1002	1045	1088	1131	1174	1217	1260	1303
0·4	1·789	1·800	1·811	1·821	1·830	1·838	1·845	1·851	1·857	1·862	1·867	1·871	1·875	1·879	1·883	1·887	1·890	1·893	1·895	1·897
	559·1	608·1	657·1	706·1	755·1	804·1	853·2	902·4	951·6	1001	1050	1099	1148	1197	1246	1296	1345	1394	1444	1494
0·5	1·986	1·999	2·011	2·022	2·032	2·041	2·049	2·056	2·062	2·066	2·071	2·076	2·081	2·086	2·091	2·095	2·098	2·102	2·104	2·106
	620·6	675·0	729·4	783·9	838·4	892·9	948·5	1003	1057	1111	1166	1220	1274	1329	1384	1439	1493	1548	1603	1658

0·6	2·160	2·175	2·188	2·200	2·210	2·219	2·228	2·236	2·243	2·249	2·255	2·260	2·265	2·270	2·275	2·279	2·283	2·286	2·289	2·292
	675·0	734·1	793·2	852·3	911·5	970·7	1030	1089	1148	1208	1268	1327	1386	1446	1506	1566	1625	1685	1745	1805
0·7	2·328	2·344	2·358	2·371	2·383	2·393	2·402	2·410	2·417	2·424	2·430	2·436	2·442	2·447	2·452	2·456	2·460	2·464	2·467	2·470
	727·5	791·4	855·3	919·2	983·1	1047	1111	1175	1239	1303	1367	1431	1495	1559	1623	1688	1752	1816	1880	1945
0·8	2·488	2·505	2·520	2·533	2·545	2·556	2·565	2·573	2·580	2·586	2·592	2·598	2·604	2·609	2·614	2·618	2·622	2·626	2·629	2·632
	777·5	845·6	913·7	981·8	1050	1118	1186	1254	1322	1390	1459	1527	1595	1663	1731	1800	1868	1936	2004	2073
0·9	2·633	2·652	2·668	2·682	2·694	2·705	2·714	2·723	2·731	2·738	2·744	2·750	2·756	2·761	2·766	2·770	2·774	2·778	2·782	2·786
	822·8	894·8	966·8	1039	1111	1183	1255	1327	1399	1471	1543	1615	1687	1759	1831	1904	1976	2048	2121	2194
1·0	2·776	2·795	2·812	2·826	2·838	2·849	2·860	2·869	2·877	2·885	2·892	2·899	2·905	2·910	2·915	2·920	2·924	2·928	2·932	2·936
	867·6	943·5	1019	1095	1171	1247	1323	1399	1475	1551	1627	1703	1779	1855	1931	2007	2083	2159	2235	2312
1·2	3·040	3·061	3·080	3·097	3·111	3·123	3·133	3·143	3·152	3·161	3·169	3·176	3·182	3·188	3·194	3·199	3·204	3·208	3·212	3·216
	950·0	1033	1116	1199	1282	1366	1449	1532	1615	1698	1782	1865	1948	2031	2115	2199	2282	2375	2459	2533
1·4	3·284	3·306	3·326	3·344	3·360	3·373	3·385	3·396	3·406	3·414	3·422	3·430	3·437	3·443	3·449	3·455	3·460	3·465	3·470	3·475
	1026	1116	1206	1296	1386	1476	1565	1655	1745	1835	1925	2015	2105	2195	2285	2375	2465	2555	2645	2736

CLASS II. ($n = 0 \cdot 030$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 5·5.

For Bottom-Widths of

Fall per thousand.	60	66	72	78	84	90	96	102	108	114	120	126	132
0·02	0·544 204·2	0·549 224·3	0·553 244·4	0·557 264·5	0·561 284·6	0·564 304·8	0·567 325·0	0·570 345·2	0·572 365·5	0·574 385·8	0·576 406·1	0·577 426·3	0·578 446·5
0·03	0·631 236·8	0·637 260·1	0·642 283·4	0·646 306·7	0·650 330·0	0·654 353·3	0·657 376·6	0·660 399·9	0·662 423·2	0·664 446·5	0·666 469·8	0·668 493·3	0·670 516·8
0·05	0·763 286·4	0·770 314·4	0·776 342·4	0·781 370·4	0·785 398·4	0·789 426·4	0·793 454·5	0·796 482·6	0·799 510·7	0·802 538·9	0·804 567·1	0·807 595·3	0·809 623·5
0·07	0·873 327·7	0·880 359·6	0·886 391·5	0·892 423·4	0·897 455·4	0·902 487·4	0·906 519·4	0·909 551·4	0·912 583·4	0·915 615·5	0·918 647·6	0·921 649·7	0·923 681·8
0·1	1·012 379·8	1·020 416·5	1·027 453·2	1·033 490·0	1·038 526·8	1·043 563·6	1·047 600·5	1·051 637·4	1·055 674·3	1·058 711·3	1·061 748·3	1·064 785·2	1·066 822·1
0·2	1·370 514·3	1·381 563·9	1·391 613·6	1·399 663·3	1·406 713·1	1·412 763·0	1·418 813·0	1·423 863·0	1·428 913·0	1·433 963·0	1·437 1013	1·441 1063	1·444 1113
0·3	1·656 621·6	1·668 681·6	1·679 741·6	1·689 801·7	1·698 861·8	1·706 921·9	1·712 981·9	1·717 1042	1·722 1102	1·727 1162	1·732 1222	1·736 1282	1·740 1342
0·4	1·902 714·0	1·915 782·2	1·927 850·6	1·937 919·0	1·946 987·0	1·955 1056	1·963 1124	1·969 1193	1·975 1262	1·981 1331	1·986 1400	1·991 1469	1·995 1538
0·5	2·109 791·6	2·125 867·8	2·140 944·0	2·152 1020	2·162 1096	2·171 1173	2·179 1249	2·186 1325	2·193 1401	2·199 1478	2·205 1555	2·210 1631	2·215 1707

0·6	2·295 861·4	2·312 944·3	2·327 1027	2·340 1110	2·351 1193	2·361 1276	2·371 1359	2·380 1442	2·387 1525	2·393 1608	2·399 1692	2·405 1775	2·410 1858
0·7	2·470 927·3	2·488 1016	2·504 1105	2·517 1194	2·529 1283	2·540 1372	2·549 1461	2·558 1550	2·566 1639	2·573 1729	2·579 1819	2·585 1908	2·591 1997
0·8	2·634 988·8	2·653 1084	2·670 1179	2·685 1274	2·698 1369	2·709 1464	2·719 1559	2·728 1654	2·737 1749	2·745 1845	2·752 1941	2·758 2036	2·764 2131
0·9	2·788 1046	2·808 1146	2·826 1246	2·841 1347	2·854 1448	2·866 1549	2·877 1649	2·887 1750	2·896 1851	2·905 1952	2·912 2053	2·918 2154	2·924 2255
1·0	2·938 1103	2·960 1208	2·979 1314	2·994 1420	3·008 1526	3·021 1632	3·033 1738	3·043 1844	3·053 1951	3·062 2058	3·070 2165	3·077 2271	3·083 2377
1·2	3·219 1208	3·241 1324	3·261 1440	3·280 1556	3·297 1672	3·311 1789	3·323 1905	3·334 2021	3·344 2138	3·354 2255	3·363 2372	3·371 2488	3·378 2604
1·4	3·476 1305	3·500 1430	3·522 1555	3·543 1670	3·561 1806	3·576 1932	3·589 2058	3·601 2184	3·612 2310	3·623 2436	3·633 2562	3·641 2688	3·648 2814

CLASS II. (n = 0·030.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 5·5.

For Bottom-Widths of

Fall per thousand.	138	144	150	156	162	168	174	180	186	192	198	204
0·02	0·580 466·8	0·582 487·1	0·583 507·4	0·584 527·6	0·585 547·8	0·586 568·0	0·587 588·2	0·587 608·4	0·588 628·5	0·589 648·6	0·590 668·7	0·590 688·8
0·03	0·672 540·3	0·674 563·8	0·675 587·4	0·677 610·9	0·678 634·4	0·679 657·9	0·680 681·4	0·681 705·0	0·682 728·4	0·683 751·8	0·683 775·2	0·684 798·5
0·05	0·811 651·8	0·813 680·1	0·814 708·4	0·816 736·7	0·818 765·0	0·819 793·3	0·820 821·6	0·821 849·9	0·822 878·2	0·823 906·5	0·824 934·8	0·825 963·2
0·07	0·925 714·0	0·927 746·2	0·929 808·4	0·931 840·5	0·932 872·6	0·933 904·8	0·935 937·0	0·936 969·2	0·937 1002	0·938 1034	0·939 1066	0·940 1098
0·1	1·068 859·0	1·070 896·0	1·072 933·0	1·074 970·0	1·076 1007	1·077 1044	1·079 1081	1·080 1118	1·081 1155	1·083 1192	1·084 1229	1·085 1266
0·2	1·447 1163	1·450 1213	1·452 1264	1·455 1314	1·457 1364	1·459 1414	1·461 1464	1·463 1515	1·465 1565	1·466 1615	1·468 1665	1·469 1715
0·3	1·743 1402	1·746 1462	1·749 1522	1·752 1582	1·754 1642	1·756 1702	1·759 1762	1·761 1823	1·763 1883	1·765 1943	1·767 2003	1·768 2064
0·4	1·999 1607	2·002 1676	2·005 1745	2·008 1814	2·011 1883	2·014 1952	2·017 2021	2·020 2090	2·022 2159	2·024 2228	2·026 2297	2·028 2367
0·5	2·219 1784	2·223 1861	2·227 1938	2·231 2014	2·234 2091	2·237 2168	2·240 2245	2·243 2322	2·245 2398	2·247 2475	2·249 2552	2·251 2629

0·6	2·415 1941	2·419 2025	2·423 2109	2·427 2192	2·430 2275	2·433 2358	2·436 2442	2·439 2526	2·442 2611	2·445 2696	2·448 2781	2·450 2860
0·7	2·596 2087	2·601 2177	2·606 2267	2·610 2356	2·613 2446	2·616 2536	2·620 2626	2·623 2716	2·626 2805	2·629 2895	2·632 2985	2·634 3075
0·8	2·769 2227	2·774 2323	2·779 2419	2·783 2514	2·787 2609	2·791 2705	2·795 2801	2·798 2897	2·801 2992	2·804 3087	2·807 3183	2·809 3279
0·9	2·930 2356	2·935 2457	2·940 2558	2·945 2659	2·949 2760	2·953 2861	2·957 2963	2·961 3065	2·964 3166	2·968 3267	2·971 3369	2·974 3471
1·0	3·089 2484	3·095 2591	3·100 2698	3·105 2804	3·109 2910	3·113 3017	3·117 3124	3·121 3231	3·124 3337	3·128 3444	3·131 3551	3·134 3658
1·2	3·384 2721	3·390 2838	3·396 2955	3·401 3071	3·406 3188	3·410 3305	3·414 3422	3·418 3539	3·422 3656	3·426 3773	3·430 3890	3·433 4007
1·4	3·655 2940	3·662 3066	3·668 3192	3·673 3318	3·678 3444	3·683 3571	3·688 3697	3·693 3824	3·697 3950	3·701 4076	3·705 4202	3·708 4328

CLASS II. ($n = 0\cdot030$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 6·0.

For Bottom-Widths of

Fall per thousand.	67	74	81	88	95	102	109	116	123	130	137	144	151	158	165
0·02	0·584 266·3	0·590 293·6	0·595 320·9	0·599 348·2	0·602 375·5	0·605 402·9	0·608 430·3	0·611 457·7	0·614 485·1	0·616 512·6	0·618 540·1	0·619 567·6	0·620 595·1	0·622 622·6	0·623 650·1
0·03	0·678 309·2	0·683 340·7	0·688 372·2	0·693 403·7	0·697 435·3	0·701 466·9	0·704 498·4	0·707 529·9	0·709 561·4	0·711 593·0	0·713 624·6	0·715 656·3	0·717 688·0	0·719 719·7	0·720 751·4
0·05	0·817 372·5	0·824 410·7	0·831 448·9	0·837 487·2	0·842 525·5	0·846 563·8	0·850 602·1	0·854 640·4	0·857 678·7	0·860 717·0	0·863 755·3	0·865 793·6	0·867 831·9	0·869 870·2	0·871 908·5
0·07	0·930 424·0	0·938 467·3	0·945 510·6	0·952 553·9	0·957 597·2	0·962 640·6	0·966 684·0	0·970 727·4	0·973 770·8	0·976 814·2	0·979 857·6	0·981 901·0	0·983 944·5	0·985 988·0	0·987 1031
0·1	1·074 489·8	1·082 538·4	1·090 588·0	1·097 637·6	1·103 687·2	1·108 737·9	1·113 787·7	1·117 837·5	1·121 887·4	1·124 937·3	1·127 987·2	1·130 1037	1·133 1087	1·135 1137	1·137 1187
0·2	1·455 663·4	1·468 730·7	1·479 798·0	1·487 865·3	1·495 932·6	1·502 1000	1·508 1067	1·514 1134	1·519 1201	1·524 1268	1·527 1337	1·530 1404	1·533 1471	1·536 1538	1·539 1605
0·3	1·753 799·3	1·765 879·4	1·776 959·7	1·787 1040	1·796 1120	1·804 1201	1·811 1281	1·817 1362	1·822 1443	1·827 1524	1·832 1605	1·836 1685	1·840 1766	1·844 1847	1·847 1928
0·4	2·010 916·7	2·025 1009	2·038 1101	2·050 1193	2·060 1285	2·069 1378	2·077 1470	2·084 1562	2·091 1655	2·097 1748	2·102 1841	2·107 1933	2·111 2025	2·115 2118	2·119 2211
0·5	2·232 1018	2·250 1120	2·265 1222	2·277 1324	2·287 1427	2·297 1530	2·306 1632	2·314 1735	2·321 1838	2·328 1941	2·334 2044	2·340 2147	2·346 2250	2·350 2353	2·354 2456

0·6	2·430 1108	2·448 1219	2·464 1330	2·477 1441	2·489 1553	2·500 1665	2·510 1776	2·518 1888	2·525 2000	2·532 2112	2·538 2224	2·544 2336	2·550 2448	2·555 2560	2·560 2672
0·7	2·612 1191	2·631 1310	2·648 1430	2·663 1550	2·676 1670	2·688 1790	2·698 1910	2·707 2030	2·715 2150	2·723 2270	2·730 2391	2·736 2511	2·742 2631	2·747 2752	2·752 2873
0·8	2·786 1270	2·806 1397	2·824 1525	2·841 1653	2·855 1781	2·867 1909	2·877 2037	2·887 2165	2·896 2293	2·904 2422	2·911 2551	2·918 2679	2·925 2807	2·930 2936	2·935 3065
0·9	2·948 1344	2·970 1479	2·990 1614	3·006 1749	3·020 1884	3·033 2020	3·046 2155	3·056 2291	3·065 2427	3·074 2563	3·081 2699	3·088 2835	3·095 2971	3·101 3107	3·107 3243
1·0	3·108 1417	3·131 1559	3·151 1702	3·168 1845	3·184 1988	3·199 2131	3·211 2274	3·221 2417	3·231 2560	3·241 2703	3·250 2847	3·258 2990	3·263 3133	3·269 3276	3·275 3419
1·2	3·402 1551	3·427 1707	3·450 1863	3·471 2019	3·489 2176	3·504 2333	3·517 2489	3·528 2646	3·539 2803	3·550 2960	3·559 3117	3·567 3274	3·574 3431	3·581 3588	3·587 3745
1·4	3·677 1677	3·704 1845	3·728 2013	3·749 2182	3·768 2351	3·785 2520	3·799 2689	3·812 2858	3·823 3027	3·834 3197	3·844 3367	3·853 3536	3·861 3705	3·868 3875	3·875 4045

CLASS II. ($n = 0 \cdot 030$.)

MEAN VELOCITIES AND QUANTITIES OF DISCHARGE PER SECOND.

FOR A DEPTH OF WATER OF 6·0.

FOR BOTTOM-WIDTHS OF

Fall per thousand.	172	179	186	193	200	207	214	221	228	235	242	249	256	263	270
0·02	0·624	0·626	0·627	0·628	0·629	0·630	0·631	0·632	0·633	0·633	0·634	0·635	0·635	0·636	0·637
	677·7	705·4	733·1	760·8	788·5	816·3	844·0	871·7	899·4	927·1	954·8	982·6	1010	1038	1066
0·03	0·721	0·723	0·724	0·725	0·726	0·727	0·728	0·729	0·730	0·730	0·731	0·732	0·732	0·733	0·734
	783·1	814·8	846·6	878·4	910·2	942·0	973·8	1006	1038	1070	1101	1133	1165	1197	1229
0·05	0·872	0·874	0·875	0·876	0·878	0·879	0·880	0·881	0·882	0·883	0·884	0·885	0·885	0·886	0·887
	946·9	985·3	1023	1061	1100	1139	1177	1215	1253	1292	1331	1369	1407	1446	1485
0·07	0·989	0·991	0·992	0·993	0·995	0·996	0·997	0·998	0·999	1·000	1·001	1·002	1·003	1·004	1·005
	1075	1118	1161	1204	1247	1291	1334	1377	1420	1464	1508	1551	1594	1638	1682
0·1	1·139	1·141	1·143	1·144	1·146	1·148	1·149	1·150	1·151	1·152	1·153	1·154	1·155	1·156	1·157
	1237	1287	1337	1387	1437	1487	1537	1587	1637	1687	1737	1787	1837	1887	1937
0·2	1·541	1·543	1·545	1·547	1·549	1·551	1·553	1·555	1·556	1·557	1·559	1·560	1·561	1·562	1·563
	1673	1740	1807	1874	1942	2010	2077	2144	2212	2280	2348	2415	2482	2549	2617
0·3	1·850	1·853	1·856	1·858	1·860	1·862	1·864	1·866	1·868	1·870	1·872	1·874	1·875	1·876	1·877
	2009	2089	2170	2251	2332	2413	2494	2575	2656	2737	2818	2899	2980	3061	3142
0·4	2·122	2·125	2·128	2·131	2·134	2·136	2·138	2·141	2·143	2·145	2·147	2·149	2·150	2·151	2·152
	2304	2396	2489	2582	2675	2768	2861	2954	3047	3140	3233	3326	3418	3511	3603
0·5	2·357	2·360	2·363	2·366	2·369	2·372	2·374	2·377	2·380	2·382	2·384	2·386	2·388	2·390	2·392
	2559	2662	2765	2868	2971	3074	3177	3280	3383	3486	3590	3693	3796	3900	4004

0·6	2·564 2784	2·568 2896	2·572 3008	2·575 3120	2·578 3232	2·581 3345	2·584 3457	2·587 3569	2·590 3681	2·592 3794	2·594 3907	2·596 4019	2·598 4131	2·600 4244	2·602 4357
0·7	2·757 2994	2·761 3114	2·765 3234	2·769 3355	2·773 3476	2·776 3597	2·779 3717	2·781 3838	2·784 3959	2·787 4080	2·790 4201	2·792 4321	2·794 4442	2·796 4563	2·798 4684
0·8	2·940 3194	2·945 3322	2·949 3450	2·953 3579	2·957 3708	2·961 3837	2·964 3965	2·967 4094	2·970 4223	2·973 4352	2·976 4481	2·978 4609	2·980 4738	2·982 4867	2·984 4996
0·9	3·112 3380	3·117 3516	3·121 3652	3·125 3788	3·129 3924	3·133 4061	3·136 4197	3·139 4333	3·142 4469	3·145 4605	3·148 4742	3·151 4878	3·154 5015	3·157 5152	3·160 5289
1·0	3·280 3563	3·285 3706	3·290 3849	3·294 3992	3·298 4136	3·302 4280	3·306 4423	3·310 4566	3·313 4710	3·316 4854	3·319 4998	3·322 5141	3·324 5285	3·327 5429	3·329 5573
1·2	3·593 3902	3·598 4059	3·603 4216	3·608 4373	3·613 4530	3·618 4688	3·622 4845	3·626 5002	3·630 5159	3·633 5317	3·636 5475	3·639 5632	3·641 5789	3·643 5946	3·645 6102
1·4	3·881 4215	3·887 4384	3·893 4553	3·898 4723	3·903 4893	3·907 5063	3·911 5232	3·915 5402	3·919 5572	3·923 5742	3·927 5912	3·930 6082	3·933 6252	3·936 6422	3·939 6593

THIRD CLASS.

RIVERS AND CANALS,

WITH BEDS AND BANKS IN BAD ORDER, HAVING IRREGULARITIES AND DEPOSITS OF STONE, AND MUCH OVERGROWN WITH VEGETATION.

$n = 0 \cdot 035.$

CLASS III. ($n = 0 \cdot 035$.)

Coefficients of Mean Velocity.

For Values of R.

Fall per thousand.	0·1	0·2	0·3	0·4	0·5	0·6
0·05	—	—	—	—	22·6	24·0
0·07	—	—	—	—	22·8	24·3
0·1	12·8	16·7	19·3	21·3	23·0	24·5
0·2	13·6	17·5	20·0	22·0	23·5	24·8
0·3	14·0	17·8	20·2	22·1	23·8	24·9
0·4	14·1	18·0	20·3	22·2	23·9	25·0
0·5	14·2	18·1	20·4	22·3	24·0	25·1
0·6	14·3	18·2	20·5	22·3	24·0	25·1
0·7	14·4	18·3	20·5	22·4	24·0	25·2
0·8	14·5	18·4	20·6	22·4	24·0	25·2
0·9	14·5	18·4	20·6	22·4	24·0	25·2
1·0	14·5	18·4	20·6	22·4	24·0	25·2

For Values of R.

Fall per thousand.	1·4	1·6	1·8	2·0	2·2
0·05	31·7	33·0	34·2	35·3	36·3
0·07	31·5	32·7	33·8	34·8	35·7
0·1	31·3	32·4	33·5	34·3	35·1
0·2	31·0	31·9	32·8	33·6	34·4
0·3	30·9	31·8	32·6	33·4	34·0
0·4	30·8	31·7	32·5	33·2	33·9
0·5	30·8	31·6	32·4	33·1	33·8
0·6	30·8	31·6	32·4	33·1	33·8
0·7	30·8	31·6	32·4	33·1	33·8
0·8	30·8	31·6	32·4	33·1	33·8
0·9	30·8	31·6	32·4	33·1	33·8
1·0	30·8	31·6	32·4	33·1	33·8

The coefficients remain unaltered for steeper inclinations.

CLASS III. ($n = 0 \cdot 035$.)

Coefficients of Mean Velocity.

For Values of R.

0·7	0·8	0·9	1·0	1·2	Fall per thousand.
25·3	26·5	27·6	28·6	30·3	0·05
25·6	26·7	27·7	28·6	30·2	0·07
25·8	26·8	27·7	28·6	30·1	0·1
26·0	26·9	27·8	28·6	30·0	0·2
26·0	27·0	27·9	28·6	30·0	0·3
26·1	27·1	27·9	28·6	30·0	0·4
26·1	27·1	27·9	28·6	30·0	0·5
26·2	27·1	27·9	28·6	30·0	0·6
26·3	27·1	27·9	28·6	30·0	0·7
26·3	27·1	27·9	28·6	30·0	0·8
26·3	27·1	27·9	28·6	30·0	0·9
26·3	27·1	27·9	28·6	30·0	1·0

For Values of R.

2·4	2·6	2·8	3·0	3·2	Fall per thousand.
37·2	38·0	38·7	39·4	40·0	0·05
36·5	37·2	37·9	38·6	39·1	0·07
35·9	36·5	37·1	37·7	38·2	0·1
35·0	35·5	36·0	36·5	37·0	0·2
34·6	35·1	35·6	36·1	36·5	0·3
34·5	35·0	35·5	35·9	36·2	0·4
34·4	34·9	35·3	35·7	36·0	0·5
34·3	34·8	35·2	35·6	35·9	0·6
34·3	34·7	35·1	35·5	35·8	0·7
34·2	34·6	35·1	35·4	35·7	0·8
34·2	34·6	35·1	35·4	35·7	0·9
34·2	34·6	35·1	35·4	35·7	1·0

The coefficients remain unaltered for steeper inclinations.

CLASS III. ($n = 0{\cdot}035$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 0·2.

For Bottom-Widths of

Fall per thousand.	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9	1·0	1·2	1·4	1·6	1·8	2·0	2·5
0·1	0·044 0·004	0·047 0·005	0·049 0·006	0·051 0·007	0·053 0·009	0·054 0·011	0·056 0·012	0·057 0·013	0·058 0·015	0·060 0·018	0·061 0·021	0·062 0·025	0·064 0·029	0·065 0·033	0·066 0·037
0·2	0·065 0·006	0·069 0·008	0·073 0·010	0·076 0·012	0·079 0·014	0·081 0·016	0·083 0·018	0·085 0·020	0·086 0·022	0·089 0·027	0·091 0·032	0·093 0·037	0·095 0·043	0·097 0·049	0·098 0·055
0·3	0·082 0·008	0·087 0·010	0·091 0·012	0·095 0·014	0·098 0·017	0·101 0·020	0·103 0·022	0·105 0·025	0·107 0·028	0·110 0·033	0·113 0·039	0·116 0·046	0·118 0·053	0·120 0·060	0·122 0·068
0·4	0·096 0·010	0·102 0·012	0·107 0·015	0·111 0·018	0·115 0·021	0·118 0·024	0·120 0·027	0·122 0·030	0·124 0·032	0·128 0·038	0·132 0·045	0·135 0·053	0·138 0·061	0·141 0·070	0·143 0·080
0·5	0·108 0·011	0·114 0·014	0·120 0·017	0·125 0·020	0·129 0·023	0·133 0·027	0·136 0·030	0·139 0·034	0·141 0·037	0·145 0·044	0·149 0·052	0·152 0·061	0·155 0·070	0·158 0·080	0·160 0·090
0·6	0·119 0·012	0·126 0·015	0·132 0·018	0·137 0·021	0·142 0·025	0·146 0·029	0·149 0·032	0·152 0·036	0·155 0·040	0·160 0·048	0·164 0·057	0·168 0·067	0·171 0·077	0·174 0·088	0·177 0·099
0·7	0·129 0·013	0·136 0·016	0·143 0·020	0·149 0·024	0·154 0·028	0·159 0·032	0·162 0·036	0·165 0·040	0·168 0·044	0·173 0·052	0·178 0·062	0·182 0·073	0·186 0·084	0·189 0·096	0·192 0·108
0·8	0·138 0·014	0·147 0·018	0·155 0·022	0·161 0·026	0·166 0·030	0·171 0·034	0·175 0·038	0·178 0·042	0·181 0·047	0·186 0·056	0·191 0·066	0·196 0·078	0·200 0·090	0·203 0·102	0·206 0·115
0·9	0·148 0·015	0·156 0·019	0·163 0·023	0·170 0·027	0·176 0·031	0·181 0·036	0·185 0·040	0·189 0·045	0·192 0·050	0·198 0·059	0·203 0·070	0·208 0·083	0·212 0·096	0·216 0·109	0·219 0·123

1·0	0·156 0·016	0·164 0·020	0·172 0·024	0·180 0·028	0·186 0·033	0·191 0·038	0·195 0·043	0·199 0·048	0·203 0·053	0·209 0·063	0·214 0·075	0·219 0·088	0·223 0·101	0·227 0·114	0·231 0·129
1·2	0·170 0·017	0·180 0·022	0·189 0·027	0·197 0·032	0·203 0·037	0·209 0·042	0·214 0·047	0·218 0·052	0·222 0·058	0·228 0·068	0·234 0·080	0·240 0·094	0·245 0·109	0·249 0·125	0·253 0·142
1·4	0·184 0·018	0·194 0·023	0·204 0·028	0·213 0·033	0·221 0·039	0·229 0·045	0·233 0·050	0·237 0·056	0·240 0·062	0·247 0·074	0·253 0·088	0·259 0·104	0·264 0·120	0·269 0·136	0·273 0·153
1·6	0·197 0·020	0·208 0·025	0·218 0·031	0·227 0·037	0·235 0·043	0·242 0·049	0·247 0·055	0·252 0·061	0·256 0·067	0·263 0·079	0·270 0·093	0·277 0·109	0·282 0·127	0·287 0·145	0·292 0·164
1·8	0·209 0·021	0·220 0·027	0·231 0·033	0·241 0·039	0·249 0·045	0·256 0·051	0·262 0·057	0·267 0·064	0·272 0·071	0·280 0·084	0·287 0·100	0·294 0·118	0·300 0·136	0·305 0·154	0·310 0·174
2·0	0·220 0·022	0·232 0·028	0·243 0·034	0·254 0·040	0·262 0·047	0·270 0·054	0·276 0·061	0·282 0·068	0·287 0·075	0·295 0·088	0·303 0·103	0·310 0·120	0·316 0·139	0·321 0·160	0·326 0·183
2·2	0·231 0·023	0·245 0·029	0·257 0·036	0·267 0·043	0·275 0·050	0·283 0·057	0·290 0·064	0·296 0·071	0·301 0·078	0·309 0·093	0·317 0·110	0·325 0·130	0·331 0·150	0·337 0·171	0·342 0·192
2·4	0·241 0·024	0·254 0·031	0·266 0·038	0·278 0·045	0·288 0·052	0·296 0·059	0·303 0·066	0·309 0·074	0·314 0·082	0·323 0·097	0·331 0·114	0·339 0·133	0·346 0·154	0·352 0·177	0·358 0·200
2·6	0·251 0·025	0·266 0·032	0·279 0·039	0·290 0·046	0·300 0·054	0·308 0·062	0·315 0·069	0·321 0·077	0·327 0·085	0·336 0·101	0·345 0·119	0·353 0·139	0·360 0·161	0·366 0·184	0·372 0·208
2·8	0·260 0·026	0·275 0·033	0·289 0·040	0·301 0·048	0·311 0·056	0·320 0·064	0·327 0·072	0·333 0·080	0·339 0·088	0·348 0·104	0·357 0·122	0·366 0·142	0·373 0·165	0·380 0·190	0·386 0·216
3·0	0·269 0·027	0·285 0·034	0·300 0·042	0·311 0·050	0·321 0·058	0·331 0·066	0·338 0·074	0·345 0·082	0·351 0·091	0·361 0·108	0·370 0·127	0·379 0·148	0·387 0·171	0·394 0·196	0·400 0·224

CLASS III. (n = 0·035.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 0·4.

For Bottom-Widths of

Fall per thousand.	0·4	0·6	0·8	1·0	1·2	1·4	1·6	1·8	2·0	2·5	3·0	3·5	4·0	4·5	5·0
0·1	0·081 0·032	0·086 0·041	0·090 0·050	0·094 0·060	0·097 0·070	0·100 0·080	0·102 0·090	0·104 0·100	0·106 0·110	0·110 0·136	0·113 0·162	0·115 0·189	0·117 0·215	0·119 0·242	0·120 0·269
0·2	0·119 0·048	0·126 0·061	0·132 0·074	0·137 0·088	0·142 0·102	0·146 0·116	0·150 0·131	0·153 0·146	0·155 0·161	0·160 0·199	0·165 0·237	0·168 0·275	0·171 0·314	0·173 0·353	0·175 0·392
0·3	0·148 0·059	0·157 0·076	0·165 0·093	0·171 0·110	0·176 0·127	0·181 0·145	0·186 0·163	0·189 0·181	0·192 0·200	0·198 0·247	0·204 0·294	0·208 0·341	0·211 0·388	0·214 0·436	0·216 0·484
0·4	0·172 0·069	0·182 0·089	0·191 0·109	0·198 0·129	0·205 0·149	0·211 0·169	0·216 0·190	0·220 0·211	0·223 0·232	0·230 0·286	0·237 0·341	0·242 0·396	0·245 0·450	0·248 0·505	0·250 0·560
0·5	0·191 0·077	0·203 0·099	0·215 0·121	0·223 0·144	0·230 0·167	0·237 0·190	0·243 0·213	0·247 0·237	0·251 0·261	0·259 0·322	0·266 0·383	0·271 0·444	0·275 0·505	0·278 0·567	0·281 0·629
0·6	0·213 0·085	0·225 0·109	0·236 0·133	0·245 0·158	0·253 0·183	0·260 0·208	0·267 0·234	0·272 0·260	0·276 0·287	0·285 0·354	0·293 0·422	0·300 0·490	0·305 0·557	0·307 0·625	0·309 0·693
0·7	0·230 0·092	0·244 0·118	0·257 0·145	0·266 0·172	0·274 0·199	0·282 0·226	0·289 0·254	0·294 0·282	0·298 0·310	0·307 0·383	0·316 0·456	0·323 0·529	0·328 0·602	0·331 0·675	0·334 0·748
0·8	0·246 0·098	0·260 0·126	0·274 0·154	0·284 0·183	0·293 0·212	0·301 0·241	0·309 0·271	0·314 0·301	0·318 0·331	0·328 0·409	0·338 0·488	0·346 0·567	0·352 0·646	0·356 0·725	0·359 0·804
0·9	0·261 0·104	0·277 0·134	0·291 0·164	0·301 0·194	0·310 0·224	0·319 0·255	0·327 0·287	0·333 0·319	0·338 0·352	0·349 0·434	0·359 0·517	0·366 0·600	0·372 0·683	0·376 0·767	0·380 0·851

1·0	0·275	0·291	0·307	0·317	0·327	0·336	0·345	0·351	0·356	0·367	0·378	0·386	0·392	0·397	0·401
	0·110	0·141	0·173	0·205	0·237	0·269	0·302	0·336	0·370	0·457	0·545	0·633	0·721	0·809	0·897
1·2	0·302	0·320	0·336	0·347	0·358	0·368	0·378	0·384	0·390	0·402	0·414	0·423	0·430	0·435	0·439
	0·121	0·155	0·190	0·225	0·260	0·295	0·331	0·368	0·406	0·502	0·598	0·694	0·790	0·886	0·983
1·4	0·326	0·345	0·363	0·375	0·387	0·398	0·408	0·415	0·421	0·434	0·447	0·456	0·463	0·469	0·474
	0·130	0·166	0·203	0·241	0·279	0·318	0·358	0·398	0·438	0·541	0·645	0·749	0·853	0·957	1·062
1·6	0·348	0·368	0·388	0·401	0·414	0·425	0·436	0·444	0·451	0·465	0·478	0·488	0·495	0·501	0·507
	0·139	0·178	0·218	0·258	0·299	0·340	0·382	0·425	0·469	0·579	0·689	0·800	0·912	1·024	1·136
1·8	0·370	0·391	0·411	0·425	0·439	0·451	0·463	0·471	0·478	0·493	0·507	0·517	0·525	0·532	0·538
	0·148	0·189	0·231	0·274	0·317	0·361	0·406	0·451	0·497	0·613	0·730	0·848	0·967	1·086	1·205
2·0	0·389	0·412	0·434	0·449	0·463	0·476	0·488	0·496	0·504	0·520	0·535	0·545	0·553	0·560	0·567
	0·156	0·200	0·245	0·290	0·335	0·381	0·428	0·476	0·524	0·646	0·769	0·894	1·019	1·144	1·270
2·2	0·409	0·424	0·438	0·462	0·485	0·499	0·512	0·519	0·528	0·546	0·561	0·573	0·582	0·589	0·595
	0·164	0·209	0·255	0·302	0·350	0·399	0·449	0·499	0·549	0·679	0·809	0·940	1·071	1·202	1·333
2·4	0·427	0·451	0·475	0·491	0·507	0·521	0·535	0·544	0·552	0·569	0·586	0·598	0·607	0·614	0·621
	0·171	0·219	0·268	0·317	0·366	0·417	0·469	0·521	0·574	0·709	0·845	0·981	1·117	1·254	1·391
2·6	0·444	0·470	0·495	0·511	0·527	0·542	0·556	0·565	0·574	0·592	0·609	0·622	0·632	0·640	0·647
	0·178	0·228	0·279	0·330	0·382	0·434	0·487	0·541	0·597	0·738	0·879	1·020	1·162	1·305	1·449
2·8	0·461	0·488	0·513	0·530	0·547	0·562	0·577	0·587	0·596	0·614	0·632	0·646	0·657	0·665	0·671
	0·184	0·236	0·289	0·342	0·395	0·450	0·506	0·563	0·620	0·766	0·912	1·059	1·206	1·354	1·503
3·0	0·477	0·505	0·531	0·550	0·567	0·582	0·597	0·607	0·617	0·636	0·655	0·669	0·680	0·689	0·695
	0·191	0·244	0·298	0·353	0·409	0·466	0·524	0·583	0·642	0·793	0·945	1·097	1·250	1·403	1·557

CLASS III. (n = 0·035.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 0·6.

For Bottom-Widths of

Fall per thousand.	0·6	0·8	1·0	1·2	1·4	1·6	1·8	2·0	2·5	3·0	3·5	4·0	4·5	5·0	5·5
0·1	0·113 0·102	0·118 0·122	0·123 0·142	0·127 0·162	0·131 0·182	0·135 0·202	0·138 0·223	0·141 0·245	0·146 0·300	0·151 0·354	0·155 0·409	0·158 0·465	0·161 0·521	0·163 0·577	0·165 0·634
0·2	0·165 0·148	0·173 0·177	0·180 0·206	0·186 0·235	0·192 0·264	0·196 0·294	0·200 0·324	0·204 0·355	0·213 0·435	0·220 0·516	0·226 0·597	0·230 0·679	0·234 0·762	0·238 0·845	0·242 0·929
0·3	0·205 0·184	0·214 0·219	0·223 0·255	0·230 0·291	0·236 0·327	0·242 0·363	0·247 0·400	0·252 0·438	0·262 0·533	0·269 0·629	0·275 0·726	0·280 0·824	0·285 0·924	0·290 1·026	0·295 1·133
0·4	0·238 0·214	0·248 0·254	0·258 0·295	0·266 0·336	0·274 0·378	0·280 0·420	0·286 0·464	0·292 0·508	0·304 0·617	0·312 0·728	0·319 0·842	0·325 0·958	0·331 1·076	0·337 1·196	0·343 1·317
0·5	0·267 0·240	0·278 0·295	0·289 0·341	0·299 0·387	0·308 0·434	0·315 0·472	0·322 0·522	0·329 0·572	0·340 0·696	0·350 0·821	0·359 0·948	0·365 1·076	0·371 1·206	0·377 1·338	0·383 1·470
0·6	0·294 0·265	0·311 0·313	0·318 0·362	0·328 0·412	0·337 0·464	0·345 0·517	0·353 0·572	0·361 0·628	0·372 0·760	0·382 0·895	0·391 1·034	0·399 1·176	0·408 1·322	0·415 1·470	0·422 1·620
0·7	0·317 0·285	0·330 0·338	0·343 0·392	0·355 0·447	0·366 0·503	0·374 0·561	0·382 0·620	0·390 0·679	0·406 0·825	0·416 0·973	0·426 1·124	0·434 1·277	0·441 1·432	0·448 1·589	0·455 1·747
0·8	0·341 0·307	0·356 0·363	0·369 0·420	0·380 0·479	0·391 0·539	0·400 0·600	0·409 0·663	0·418 0·727	0·432 0·884	0·444 1·043	0·456 1·204	0·463 1·366	0·470 1·530	0·477 1·694	0·484 1·859
0·9	0·360 0·324	0·376 0·385	0·391 0·447	0·403 0·510	0·415 0·573	0·425 0·637	0·434 0·704	0·444 0·772	0·459 0·937	0·471 1·104	0·483 1·275	0·491 1·447	0·499 1·621	0·506 1·795	0·513 1·970

1·0	0·379 0·341	0·396 0·405	0·412 0·470	0·425 0·536	0·437 0·603	0·447 0·670	0·457 0·741	0·467 0·813	0·483 0·988	0·496 1·165	0·509 1·344	0·517 1·525	0·525 1·708	0·533 1·892	0·541 2·077
1·2	0·415 0·373	0·434 0·443	0·452 0·514	0·466 0·587	0·479 0·661	0·490 0·735	0·500 0·811	0·510 0·887	0·530 1·080	0·544 1·275	0·558 1·473	0·567 1·672	0·576 1·872	0·584 2·072	0·592 2·273
1·4	0·448 0·403	0·468 0·477	0·488 0·553	0·503 0·631	0·517 0·711	0·529 0·793	0·541 0·877	0·553 0·962	0·572 1·170	0·588 1·380	0·603 1·592	0·613 1·806	0·622 2·022	0·631 2·239	0·640 2·457
1·6	0·480 0·432	0·501 0·511	0·521 0·592	0·537 0·675	0·553 0·760	0·566 0·849	0·578 0·938	0·590 1·027	0·611 1·249	0·628 1·473	0·644 1·700	0·655 1·929	0·665 2·160	0·675 2·394	0·685 2·630
1·8	0·509 0·458	0·531 0·542	0·553 0·628	0·570 0·716	0·587 0·807	0·600 0·900	0·613 0·994	0·626 1·089	0·649 1·324	0·666 1·562	0·683 1·803	0·694 2·047	0·705 2·294	0·716 2·543	0·727 2·792
2·0	0·536 0·482	0·560 0·571	0·583 0·662	0·601 0·755	0·618 0·850	0·632 0·948	0·646 1·048	0·660 1·148	0·682 1·396	0·701 1·646	0·720 1·900	0·732 2·156	0·743 2·414	0·754 2·675	0·765 2·938
2·2	0·562 0·506	0·587 0·600	0·611 0·696	0·630 0·794	0·649 0·894	0·664 0·996	0·678 1·100	0·692 1·204	0·717 1·466	0·737 1·730	0·756 1·996	0·768 2·264	0·780 2·534	0·791 2·806	0·802 3·080
2·4	0·587 0·528	0·614 0·626	0·639 0·726	0·660 0·828	0·678 0·933	0·693 1·039	0·708 1·148	0·723 1·258	0·749 1·530	0·769 1·805	0·789 2·083	0·802 2·364	0·814 2·648	0·826 2·933	0·838 3·218
2·6	0·611 0·550	0·639 0·650	0·665 0·753	0·685 0·859	0·705 0·968	0·721 1·081	0·737 1·195	0·753 1·310	0·780 1·593	0·795 1·879	0·821 2·167	0·834 2·458	0·847 2·753	0·860 3·051	0·873 3·352
2·8	0·634 0·571	0·662 0·675	0·690 0·782	0·711 0·892	0·732 1·006	0·749 1·123	0·765 1·241	0·781 1·359	0·809 1·652	0·831 1·949	0·852 2·249	0·866 2·552	0·880 2·859	0·893 3·168	0·906 3·479
3·0	0·657 0·591	0·686 0·699	0·714 0·810	0·736 0·924	0·757 1·041	0·775 1·162	0·792 1·284	0·809 1·408	0·837 1·710	0·860 2·017	0·882 2·329	0·896 2·644	0·910 2·962	0·924 3·282	0·938 3·601

CLASS III. ($n = 0\cdot035$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 0·8.

For Bottom-Widths of

Fall per thousand.	1·0	1·2	1·4	1·6	1·8	2·0	2·5	3·0	3·5	4·0	4·5	5·0	5·5	6·0	6·5
0·05	0·103 0·181	0·107 0·204	0·110 0·228	0·113 0·252	0·115 0·276	0·117 0·299	0·122 0·360	0·126 0·422	0·129 0·486	0·132 0·550	0·135 0·614	0·137 0·679	0·139 0·744	0·140 0·809	0·142 0·875
0·1	0·148 0·260	0·153 0·294	0·158 0·328	0·162 0·363	0·165 0·397	0·168 0·430	0·175 0·519	0·181 0·609	0·186 0·699	0·190 0·790	0·194 0·882	0·197 0·977	0·200 1·072	0·203 1·167	0·205 1·263
0·2	0·216 0·380	0·223 0·428	0·229 0·476	0·234 0·524	0·239 0·573	0·243 0·622	0·252 0·745	0·260 0·872	0·266 1·000	0·272 1·129	0·276 1·259	0·280 1·389	0·284 1·520	0·287 1·652	0·290 1·786
0·3	0·266 0·468	0·275 0·527	0·283 0·587	0·289 0·647	0·295 0·707	0·300 0·768	0·311 0·921	0·321 1·076	0·328 1·233	0·335 1·390	0·340 1·559	0·345 1·711	0·350 1·873	0·354 2·036	0·357 2·199
0·4	0·309 0·544	0·319 0·613	0·328 0·682	0·335 0·751	0·342 0·821	0·348 0·891	0·361 1·069	0·373 1·249	0·381 1·432	0·388 1·617	0·395 1·802	0·401 1·988	0·406 2·175	0·410 2·362	0·414 2·550
0·5	0·347 0·611	0·358 0·688	0·369 0·766	0·377 0·844	0·384 0·922	0·391 1·001	0·405 1·200	0·418 1·403	0·427 1·606	0·436 1·811	0·443 2·019	0·450 2·230	0·455 2·439	0·460 2·648	0·464 2·858
0·6	0·380 0·669	0·392 0·753	0·404 0·838	0·412 0·923	0·420 1·009	0·428 1·096	0·443 1·314	0·458 1·535	0·468 1·759	0·477 1·986	0·485 2·215	0·493 2·445	0·499 2·675	0·504 2·905	0·509 3·135
0·7	0·412 0·725	0·424 0·816	0·436 0·907	0·446 0·999	0·453 1·092	0·463 1·185	0·480 1·421	0·495 1·661	0·507 1·906	0·518 2·153	0·527 2·402	0·535 2·653	0·542 2·904	0·547 3·155	0·553 3·406
0·8	0·441 0·776	0·454 0·873	0·466 0·970	0·477 1·068	0·487 1·167	0·495 1·267	0·513 1·521	0·529 1·778	0·542 2·038	0·553 2·300	0·562 2·564	0·571 2·832	0·578 3·101	0·585 3·371	0·591 3·641

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0·9	0·467 0·822	0·482 0·925	0·495 1·029	0·506 1·133	0·516 1·238	0·525 1·344	0·544 1·612	0·561 1·884	0·575 2·162	0·587 2·442	0·597 2·723	0·606 3·006	0·613 3·290	0·620 3·575	0·627 3·862
1·0	0·497 0·875	0·510 0·980	0·521 1·087	0·533 1·195	0·544 1·305	0·553 1·416	0·573 1·700	0·591 1·988	0·606 2·279	0·619 2·573	0·630 2·870	0·639 3·170	0·647 3·470	0·654 3·771	0·661 4·072
1·2	0·540 0·950	0·557 1·069	0·571 1·188	0·584 1·308	0·596 1·429	0·606 1·551	0·628 1·861	0·648 2·176	0·664 2·497	0·680 2·820	0·690 3·145	0·700 3·472	0·708 3·800	0·716 4·129	0·724 4·460
1·4	0·583 1·026	0·600 1·155	0·617 1·284	0·631 1·413	0·643 1·543	0·654 1·674	0·677 2·009	0·698 2·349	0·717 2·696	0·732 3·045	0·744 3·396	0·756 3·750	0·765 4·105	0·774 4·461	0·782 4·817
1·6	0·623 1·096	0·643 1·234	0·660 1·372	0·674 1·510	0·687 1·649	0·699 1·789	0·725 2·148	0·748 2·512	0·766 2·880	0·783 3·252	0·796 3·628	0·808 4·008	0·818 4·388	0·827 4·769	0·836 5·150
1·8	0·661 1·163	0·682 1·309	0·700 1·455	0·715 1·602	0·729 1·750	0·742 1·899	0·769 2·280	0·794 2·667	0·814 3·061	0·830 3·456	0·844 3·852	0·857 4·251	0·867 4·653	0·877 5·055	0·886 5·458
2·0	0·704 1·239	0·722 1·388	0·739 1·539	0·755 1·691	0·769 1·846	0·782 2·002	0·810 2·404	0·836 2·812	0·858 3·226	0·875 3·643	0·890 4·062	0·904 4·483	0·914 4·905	0·924 5·328	0·934 5·753
2·2	0·731 1·286	0·753 1·446	0·773 1·608	0·790 1·770	0·806 1·934	0·820 2·100	0·850 2·520	0·877 2·947	0·899 3·380	0·918 3·818	0·934 4·259	0·948 4·702	0·960 5·146	0·970 5·591	0·980 6·037
2·4	0·763 1·343	0·787 1·511	0·808 1·680	0·826 1·850	0·842 2·021	0·857 2·194	0·888 2·630	0·914 3·073	0·937 3·523	0·957 3·978	0·974 4·437	0·988 4·900	1·001 5·366	1·012 5·833	1·023 6·302
2·6	0·794 1·397	0·819 1·571	0·841 1·747	0·859 1·924	0·876 2·102	0·891 2·281	0·924 2·738	0·954 3·202	0·977 3·674	0·998 4·150	1·015 4·628	1·030 5·109	1·043 5·591	1·054 6·075	1·065 6·560
2·8	0·824 1·450	0·850 1·630	0·872 1·812	0·891 1·996	0·908 2·182	0·925 2·368	0·959 2·847	0·989 3·330	1·015 3·817	1·036 4·307	1·054 4·800	1·068 5·297	1·082 5·797	1·094 6·300	1·105 6·806
3·0	0·853 1·501	0·880 1·689	0·903 1·878	0·923 2·067	0·941 2·258	0·958 2·452	0·993 2·946	1·025 3·445	1·050 3·948	1·072 4·457	1·090 4·971	1·107 5·490	1·120 6·009	1·132 6·528	1·144 7·047

CLASS III. ($n = 0\cdot035$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 1·0.

For Bottom-Widths of

Fall per thousand.	2·0	2·5	3·0	3·5	4·0	4·5	5·0	5·5	6·0	6·5	7·0	7·5	8·0	8·5	9·0
0·05	0·136 0·471	0·141 0·564	0·146 0·657	0·150 0·750	0·154 0·846	0·157 0·942	0·160 1·038	0·162 1·134	0·164 1·230	0·166 1·327	0·168 1·424	0·169 1·521	0·171 1·620	0·172 1·720	0·173 1·820
0·1	0·196 0·679	0·203 0·812	0·210 0·946	0·216 1·080	0·221 1·215	0·225 1·350	0·229 1·487	0·232 1·624	0·235 1·762	0·238 1·900	0·240 2·039	0·242 2·178	0·244 2·319	0·246 2·660	0·247 2·801
0·2	0·281 0·978	0·291 1·164	0·300 1·351	0·308 1·541	0·315 1·733	0·321 1·925	0·326 2·118	0·330 2·311	0·334 2·506	0·338 2·702	0·341 2·899	0·344 3·096	0·347 3·293	0·349 3·490	0·351 3·688
0·3	0·345 1·205	0·358 1·432	0·369 1·660	0·378 1·890	0·386 2·124	0·393 2·360	0·400 2·599	0·406 2·840	0·411 3·079	0·415 3·320	0·419 3·562	0·423 3·804	0·426 4·047	0·429 4·290	0·432 4·534
0·4	0·400 1·425	0·415 1·660	0·428 1·826	0·439 2·195	0·448 2·365	0·456 2·736	0·463 2·912	0·470 3·290	0·476 3·469	0·481 3·848	0·486 4·028	0·490 4·408	0·493 4·587	0·496 4·966	0·498 5·145
0·5	0·449 1·568	0·465 1·860	0·478 2·153	0·490 2·450	0·500 2·759	0·509 3·054	0·518 3·367	0·526 3·682	0·533 3·997	0·539 4·312	0·544 4·624	0·548 4·932	0·551 5·238	0·554 5·540	0·557 5·840
0·6	0·492 1·730	0·512 2·048	0·527 2·368	0·539 2·695	0·550 3·025	0·560 3·360	0·569 3·699	0·577 4·039	0·584 4·379	0·590 4·720	0·595 5·060	0·600 5·400	0·604 5·737	0·607 6·070	0·610 6·400
0·7	0·533 1·860	0·552 2·208	0·568 2·558	0·583 2·915	0·596 3·275	0·607 3·642	0·616 4·008	0·625 4·375	0·632 4·739	0·638 5·104	0·643 5·468	0·648 5·832	0·652 6·196	0·656 6·560	0·659 6·924
0·8	0·570 1·990	0·591 2·364	0·609 2·740	0·624 3·120	0·637 3·502	0·648 3·888	0·658 4·277	0·667 4·669	0·675 5·063	0·682 5·456	0·688 5·847	0·693 6·237	0·697 6·625	0·701 7·010	0·705 7·393

0·9	0·605 2·113	0·627 2·508	0·646 2·905	0·662 3·310	0·676 3·719	0·688 4·128	0·698 4·538	0·707 4·949	0·715 5·362	0·722 5·776	0·728 6·191	0·734 6·606	0·739 7·020	0·743 7·430	0·747 7·840
1·0	0·637 2·224	0·661 2·644	0·681 3·066	0·698 3·490	0·712 3·915	0·724 4·344	0·735 4·777	0·745 5·215	0·754 5·655	0·762 6·096	0·769 6·536	0·775 6·974	0·780 7·409	0·784 7·840	0·788 8·270
1·2	0·698 2·446	0·724 2·896	0·746 3·351	0·764 3·820	0·780 4·290	0·794 4·764	0·806 5·241	0·817 5·719	0·826 5·796	0·834 6·674	0·841 7·152	0·848 7·630	0·854 8·110	0·859 8·590	0·863 9·070
1·4	0·754 2·628	0·782 3·128	0·806 3·628	0·826 4·130	0·843 4·633	0·857 5·142	0·870 5·653	0·881 6·167	0·891 6·683	0·900 7·200	0·908 7·717	0·915 8·235	0·921 8·752	0·927 9·270	0·932 9·787
1·6	0·806 2·813	0·836 3·344	0·861 3·877	0·883 4·415	0·901 4·954	0·916 5·496	0·930 6·046	0·942 6·596	0·952 7·148	0·962 7·700	0·971 8·255	0·979 8·811	0·986 9·365	0·992 9·920	0·997 10·46
1·8	0·855 2·980	0·886 3·544	0·913 4·110	0·936 4·680	0·955 5·251	0·971 5·826	0·985 6·404	0·998 6·986	1·010 7·576	1·021 8·168	1·030 8·756	1·038 9·342	1·045 9·927	1·051 10·51	1·057 11·09
2·0	0·901 3·140	0·934 3·736	0·963 4·334	0·987 4·935	1·007 5·539	1·024 6·147	1·040 6·760	1·054 7·377	1·066 7·993	1·076 8·609	1·085 9·227	1·094 9·846	1·101 10·46	1·108 11·08	1·114 11·70
2·2	0·946 3·296	0·980 3·920	1·010 4·545	1·035 5·175	1·057 5·807	1·074 6·444	1·090 7·087	1·105 7·735	1·118 8·383	1·129 9·032	1·139 9·681	1·148 10·33	1·156 10·98	1·163 11·63	1·169 12·28
2·4	0·988 3·450	1·024 4·096	1·055 4·746	1·081 5·405	1·104 6·070	1·124 6·740	1·140 7·411	1·154 8·082	1·167 8·756	1·179 9·432	1·190 10·11	1·200 10·79	1·208 11·47	1·215 12·15	1·222 12·83
2·6	1·028 3·588	1·066 4·264	1·099 4·942	1·125 5·625	1·147 6·311	1·167 7·004	1·186 7·708	1·202 8·410	1·215 9·110	1·226 9·810	1·236 10·51	1·246 11·21	1·255 11·91	1·262 12·62	1·271 13·32
2·8	1·067 3·720	1·106 4·424	1·140 5·130	1·168 5·840	1·192 6·555	1·212 7·272	1·229 7·989	1·244 8·708	1·258 9·437	1·271 10·17	1·283 10·90	1·294 11·64	1·303 12·37	1·311 13·11	1·318 13·90
3·0	1·104 3·846	1·144 4·576	1·179 5·308	1·209 6·045	1·234 6·782	1·254 7·524	1·272 8·268	1·288 9·016	1·302 9·766	1·315 10·52	1·327 11·28	1·338 12·04	1·348 12·80	1·357 13·57	1·365 14·33

CLASS III. ($n = 0·035.$)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 1·2.

For Bottom-Widths of

Fall per thousand.	3·5	4·0	4·5	5·0	5·5	6·0	6·5	7·0	7·5	8·0	8·5	9·0	9·5	10	11
0·05	0·170 1·081	0·174 1·208	0·177 1·338	0·180 1·469	0·183 1·603	0·186 1·737	0·188 1·872	0·190 2·007	0·192 2·143	0·194 2·281	0·196 2·422	0·197 2·563	0·199 2·704	0·201 2·846	0·203 3·118
0·1	0·242 1·539	0·248 1·725	0·253 1·912	0·257 2·098	0·261 2·285	0·264 2·474	0·267 2·663	0·270 2·853	0·273 3·046	0·276 3·241	0·278 3·436	0·280 3·631	0·282 3·826	0·284 4·021	0·286 4·393
0·2	0·344 2·188	0·352 2·451	0·359 2·714	0·365 2·977	0·370 3·241	0·375 3·507	0·379 3·775	0·383 4·047	0·387 4·319	0·390 4·589	0·393 4·859	0·396 5·134	0·399 5·411	0·402 5·690	0·405 6·220
0·3	0·423 2·690	0·432 3·006	0·440 3·326	0·447 3·649	0·454 3·977	0·460 4·307	0·466 4·638	0·471 4·969	0·475 5·301	0·479 5·634	0·483 5·970	0·487 6·307	0·490 6·644	0·493 6·981	0·496 7·619
0·4	0·490 3·117	0·501 3·486	0·510 3·855	0·518 4·227	0·525 4·599	0·531 4·971	0·537 5·348	0·543 5·729	0·548 6·115	0·553 6·504	0·557 6·885	0·561 7·275	0·565 7·666	0·569 8·057	0·573 8·800
0·5	0·548 3·485	0·560 3·896	0·570 4·309	0·579 4·714	0·587 5·142	0·594 5·563	0·601 5·985	0·607 6·406	0·612 6·830	0·617 7·257	0·622 7·688	0·627 8·124	0·632 8·563	0·636 9·005	0·640 9·831
0·6	0·600 3·816	0·614 4·270	0·625 4·725	0·634 5·181	0·643 5·637	0·651 6·095	0·658 6·554	0·665 7·014	0·670 7·477	0·676 7·945	0·681 8·418	0·686 8·894	0·691 9·373	0·696 9·856	0·701 10·77
0·7	0·648 4·121	0·663 4·610	0·675 5·100	0·685 5·590	0·694 6·080	0·703 6·580	0·711 7·080	0·718 7·580	0·724 8·080	0·730 8·585	0·736 9·097	0·742 9·612	0·747 10·13	0·752 10·65	0·757 11·63
0·8	0·693 4·407	0·709 4·927	0·721 5·450	0·732 5·973	0·742 6·500	0·751 7·032	0·760 7·570	0·768 8·115	0·776 8·660	0·783 9·205	0·789 9·750	0·794 10·29	0·799 10·83	0·804 11·38	0·810 12·44

0·9	0·735 4·674	0·752 5·228	0·765 5·783	0·776 6·337	0·787 6·896	0·797 7·459	0·806 8·026	0·814 8·594	0·821 9·162	0·828 9·734	0·834 10·31	0·840 10·89	0·846 11·47	0·852 12·06	0·860 13·21
1·0	0·775 4·929	0·792 5·505	0·805 6·085	0·817 6·665	0·828 7·253	0·839 7·855	0·849 8·457	0·858 9·061	0·866 9·665	0·873 10·27	0·879 10·87	0·885 11·47	0·891 12·08	0·897 12·70	0·905 13·90
1·2	0·849 5·400	0·868 6·038	0·883 6·676	0·896 7·314	0·908 7·954	0·919 8·604	0·930 9·262	0·940 9·926	0·949 10·59	0·957 11·25	0·964 11·91	0·970 12·57	0·976 13·23	0·982 13·90	0·991 15·22
1·4	0·917 5·831	0·937 6·522	0·954 7·213	0·969 7·907	0·982 8·602	0·994 9·300	1·005 10·01	1·015 10·72	1·024 11·43	1·032 12·14	1·040 12·85	1·048 13·57	1·055 14·30	1·062 15·04	1·071 16·45
1·6	0·980 6·233	1·002 6·971	1·020 7·711	1·036 8·452	1·050 9·198	1·063 9·948	1·074 10·70	1·085 11·46	1·095 12·22	1·104 12·98	1·112 13·74	1·120 14·51	1·127 15·28	1·134 16·06	1·145 17·59
1·8	1·040 6·614	1·063 7·390	1·081 8·171	1·097 8·951	1·112 9·741	1·126 10·54	1·139 11·34	1·151 12·15	1·162 12·97	1·172 13·78	1·181 14·60	1·189 15·41	1·197 16·23	1·204 17·05	1·215 18·66
2·0	1·096 6·971	1·120 7·793	1·140 8·618	1·157 9·443	1·173 10·27	1·188 11·12	1·202 11·97	1·214 12·82	1·225 13·67	1·235 14·52	1·244 15·37	1·253 16·23	1·261 17·10	1·269 17·97	1·280 19·66
2·2	1·151 7·320	1·175 8·174	1·195 9·034	1·213 9·898	1·230 10·77	1·246 11·66	1·260 12·55	1·273 13·44	1·285 14·34	1·295 15·23	1·304 16·13	1·313 17·06	1·322 17·99	1·331 18·93	1·343 20·63
2·4	1·200 7·631	1·227 8·531	1·248 9·434	1·267 10·34	1·284 11·25	1·300 12·17	1·315 13·10	1·329 14·03	1·341 14·96	1·352 15·89	1·362 16·83	1·372 17·77	1·381 18·72	1·390 19·68	1·403 21·55
2·6	1·250 7·950	1·277 8·885	1·299 9·820	1·319 10·76	1·337 11·71	1·354 12·67	1·369 13·63	1·383 14·60	1·396 15·58	1·407 16·55	1·418 17·53	1·428 18·51	1·438 19·50	1·448 20·50	1·460 22·42
2·8	1·297 8·249	1·326 9·224	1·349 10·20	1·369 11·18	1·387 12·15	1·404 13·14	1·420 14·14	1·435 15·15	1·449 16·16	1·461 17·07	1·472 18·19	1·482 19·21	1·492 20·23	1·502 21·26	1·515 23·27
3·0	1·342 8·535	1·372 9·537	1·394 10·54	1·417 11·56	1·437 12·59	1·454 13·62	1·471 14·65	1·486 15·69	1·500 16·73	1·512 17·77	1·523 18·82	1·534 19·88	1·545 20·95	1·555 22·02	1·568 24·08

CLASS III. ($n = 0\cdot035$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 1·4.

For Bottom-Widths of

Fall per thousand.	5·0	5·5	6·0	6·5	7·0	7·5	8·0	8·5	9·0	9·5	10	11	12	13	14
0·05	0·201 1·998	0·204 2·172	0·207 2·347	0·209 2·523	0·212 2·700	0·214 2·877	0·216 3·054	0·217 3·231	0·219 3·408	0·221 3·590	0·223 3·774	0·225 4·125	0·227 4·481	0·229 4·842	0·231 5·207
0·1	0·284 2·823	0·288 3·066	0·292 3·310	0·295 3·553	0·298 3·797	0·301 4·047	0·304 4·298	0·306 4·549	0·309 4·800	0·311 5·051	0·313 5·303	0·317 5·810	0·320 6·314	0·323 6·821	0·325 7·325
0·2	0·402 3·996	0·408 4·340	0·413 4·684	0·418 5·030	0·422 5·376	0·426 5·727	0·430 6·080	0·434 6·435	0·437 6·790	0·440 7·147	0·443 7·504	0·448 8·210	0·452 8·923	0·456 9·643	0·460 10·37
0·3	0·492 4·891	0·499 5·307	0·505 5·727	0·511 6·148	0·516 6·574	0·521 7·004	0·526 7·437	0·531 7·873	0·535 8·310	0·539 8·746	0·542 9·183	0·548 10·06	0·554 10·93	0·559 11·81	0·563 12·69
0·4	0·568 5·645	0·577 6·132	0·584 6·620	0·590 7·106	0·596 7·595	0·602 8·096	0·608 8·598	0·613 9·099	0·618 9·600	0·622 10·10	0·626 10·60	0·633 11·60	0·639 12·61	0·645 13·63	0·650 14·65
0·5	0·635 6·312	0·644 6·852	0·652 7·394	0·659 7·936	0·666 8·484	0·673 9·041	0·679 9·600	0·685 10·16	0·691 10·73	0·696 11·29	0·700 11·86	0·708 12·98	0·715 14·11	0·721 15·25	0·727 16·39
0·6	0·696 6·918	0·706 7·504	0·714 8·097	0·722 8·695	0·730 9·300	0·738 9·912	0·745 10·53	0·751 11·14	0·757 11·76	0·762 12·37	0·767 12·99	0·775 14·22	0·783 15·45	0·790 16·69	0·796 17·94
0·7	0·751 7·470	0·763 8·115	0·773 8·760	0·781 9·405	0·789 10·05	0·797 10·71	0·804 11·37	0·811 12·03	0·817 12·70	0·823 13·36	0·828 14·02	0·837 15·36	0·846 16·70	0·853 18·04	0·860 19·38
0·8	0·803 7·982	0·815 8·667	0·825 9·356	0·834 10·05	0·843 10·74	0·852 11·44	0·860 12·15	0·867 12·86	0·873 13·57	0·879 14·28	0·885 14·99	0·895 16·41	0·904 17·84	0·912 19·27	0·920 20·73

0·9	0·852 8·468	0·864 9·190	0·875 9·922	0·885 10·66	0·895 11·40	0·904 12·14	0·912 12·89	0·920 13·64	0·927 14·40	0·933 15·15	0·939 15·91	0·949 17·41	0·959 18·93	0·968 20·46	0·976 22·00
1·0	0·898 8·927	0·911 9·682	0·922 10·45	0·933 11·23	0·943 12·01	0·952 12·80	0·961 13·59	0·969 14·38	0·977 15·18	0·984 15·97	0·990 16·77	1·001 18·36	1·011 19·96	1·020 21·57	1·029 23·19
1·2	0·984 9·781	0·999 10·62	1·011 11·46	1·022 12·31	1·033 13·16	1·043 14·02	1·053 14·89	1·062 15·76	1·070 16·63	1·077 17·49	1·084 18·36	1·096 20·09	1·107 21·85	1·117 23·61	1·127 25·40
1·4	1·063 10·56	1·079 11·47	1·092 12·38	1·104 13·30	1·116 14·22	1·127 15·15	1·137 16·08	1·147 17·01	1·155 17·95	1·163 18·89	1·171 19·84	1·184 21·71	1·196 23·61	1·207 25·51	1·217 27·43
1·6	1·136 11·29	1·153 12·26	1·167 13·23	1·180 14·21	1·193 15·20	1·205 16·19	1·216 17·19	1·227 18·19	1·236 19·20	1·244 20·20	1·252 21·21	1·265 23·21	1·278 25·23	1·290 27·26	1·301 29·32
1·8	1·205 11·98	1·223 12·91	1·239 14·05	1·252 15·08	1·265 16·12	1·277 17·17	1·289 18·22	1·300 19·28	1·310 20·35	1·319 21·42	1·328 22·50	1·342 24·63	1·356 26·78	1·370 28·96	1·383 31·17
2·0	1·270 12·62	1·289 13·71	1·305 14·80	1·319 15·89	1·333 16·99	1·346 18·10	1·359 19·22	1·371 20·34	1·381 21·46	1·391 22·58	1·400 23·71	1·415 25·95	1·429 28·21	1·442 30·48	1·454 32·77
2·2	1·332 13·24	1·352 14·38	1·369 15·52	1·384 16·66	1·398 17·81	1·411 18·96	1·423 20·12	1·435 21·30	1·447 22·48	1·458 23·67	1·468 24·86	1·484 27·20	1·498 29·57	1·512 31·96	1·525 34·37
2·4	1·391 13·82	1·412 15·01	1·429 16·20	1·445 17·40	1·460 18·60	1·475 19·82	1·489 21·05	1·502 22·28	1·513 23·51	1·523 24·74	1·533 25·97	1·550 28·43	1·566 30·91	1·580 33·41	1·593 35·91
2·6	1·448 14·39	1·470 15·63	1·488 16·87	1·504 18·12	1·520 19·37	1·535 20·63	1·549 21·90	1·563 23·18	1·574 24·46	1·585 25·74	1·596 27·03	1·613 29·58	1·629 32·16	1·644 34·75	1·658 37·37
2·8	1·503 14·94	1·525 16·22	1·544 17·51	1·561 18·80	1·577 20·09	1·593 21·41	1·608 22·73	1·622 24·06	1·634 25·39	1·645 26·72	1·656 28·05	1·674 30·70	1·690 33·36	1·706 36·06	1·721 38·79
3·0	1·557 15·48	1·579 16·80	1·598 18·12	1·616 19·46	1·633 20·80	1·649 22·16	1·664 23·53	1·678 24·90	1·691 26·28	1·703 27·62	1·714 29·03	1·732 31·75	1·749 34·52	1·765 37·32	1·781 40·14

CLASS III. (n = 0·035.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 1·6.

For Bottom-Widths of

Fall per thousand.	7·0	7·5	8·0	8·5	9·0	9·5	10	11	12	13	14	15	16	17	18
0·05	0·231 3·474	0·234 3·699	0·236 3·924	0·238 4·150	0·240 4·377	0·242 4·607	0·244 4·840	0·247 5·302	0·250 5·760	0·252 6·215	0·254 6·670	0·256 7·130	0·258 7·590	0·260 8·051	0·261 8·519
0·1	0·323 4·857	0·327 5·174	0·330 5·491	0·333 5·810	0·336 6·129	0·339 6·454	0·342 6·786	0·345 7·397	0·348 8·018	0·351 8·649	0·354 9·290	0·357 9·940	0·360 10·59	0·362 11·23	0·364 11·88
0·2	0·459 6·904	0·463 7·336	0·467 7·771	0·471 8·208	0·474 8·646	0·477 9·085	0·480 9·524	0·486 10·41	0·490 11·29	0·494 12·18	0·498 13·07	0·502 13·97	0·505 14·87	0·508 15·77	0·511 16·68
0·3	0·562 8·453	0·567 8·985	0·572 9·517	0·576 10·05	0·580 10·58	0·584 11·11	0·587 11·65	0·594 12·73	0·599 13·81	0·604 14·89	0·609 15·98	0·614 17·07	0·618 18·16	0·621 19·26	0·624 20·36
0·4	0·649 9·761	0·655 10·37	0·660 10·98	0·665 11·59	0·669 12·20	0·673 12·81	0·677 13·43	0·685 14·67	0·691 15·91	0·696 17·15	0·701 18·39	0·706 19·64	0·710 20·89	0·714 22·14	0·717 23·40
0·5	0·723 10·87	0·730 11·56	0·737 12·26	0·744 12·95	0·749 13·64	0·753 14·33	0·757 15·02	0·764 16·39	0·770 17·76	0·776 19·14	0·782 20·52	0·787 21·91	0·791 23·30	0·795 24·69	0·799 26·08
0·6	0·792 11·91	0·800 12·66	0·808 13·42	0·815 14·18	0·820 14·94	0·825 15·70	0·830 16·46	0·837 17·95	0·844 19·45	0·850 20·95	0·856 22·46	0·862 23·97	0·867 25·49	0·871 27·02	0·875 28·56
0·7	0·856 12·87	0·864 13·69	0·872 14·51	0·880 15·32	0·886 16·13	0·891 16·95	0·896 17·77	0·904 19·39	0·911 21·01	0·918 22·64	0·925 24·27	0·931 25·91	0·936 27·55	0·941 29·19	0·945 30·84
0·8	0·915 13·76	0·924 14·64	0·933 15·52	0·941 16·39	0·947 17·26	0·953 18·13	0·958 19·00	0·966 20·73	0·974 22·47	0·982 24·21	0·989 25·95	0·995 27·70	1·001 29·46	1·006 31·23	1·011 33·00

0·9	0·970 14·59	0·980 15·52	0·989 16·45	0·997 17·38	1·004 18·31	1·010 19·23	1·016 20·15	1·025 21·99	1·033 23·83	1·041 25·67	1·049 27·52	1·056 29·38	1·062 31·24	1·067 33·11	1·072 34·98
1·0	1·023 15·38	1·034 16·37	1·044 17·36	1·053 18·34	1·060 19·31	1·066 20·28	1·071 21·24	1·080 23·16	1·089 25·09	1·097 27·03	1·105 28·99	1·112 30·96	1·119 32·93	1·125 34·90	1·130 36·88
1·2	1·120 16·84	1·131 17·91	1·141 18·98	1·150 20·05	1·158 21·12	1·166 22·19	1·173 23·27	1·183 25·38	1·193 27·50	1·202 29·63	1·211 31·77	1·219 33·92	1·226 36·08	1·232 38·24	1·238 40·41
1·4	1·209 18·18	1·222 19·34	1·234 20·50	1·244 21·66	1·253 22·82	1·260 23·98	1·267 25·13	1·278 27·42	1·289 29·71	1·299 32·01	1·308 34·32	1·316 36·64	1·323 38·97	1·330 41·30	1·337 43·64
1·6	1·294 19·46	1·307 20·70	1·319 21·95	1·331 23·19	1·341 24·42	1·349 25·65	1·355 26·88	1·366 29·31	1·377 31·76	1·388 34·22	1·398 36·68	1·407 39·16	1·415 41·66	1·423 44·17	1·430 46·68
1·8	1·372 20·63	1·388 21·96	1·401 23·30	1·413 24·61	1·423 25·92	1·431 27·22	1·437 28·52	1·449 31·10	1·461 33·79	1·472 36·39	1·483 38·91	1·493 41·54	1·501 44·18	1·509 46·83	1·516 49·48
2·0	1·446 21·74	1·461 23·12	1·475 24·50	1·488 25·89	1·499 27·28	1·508 28·67	1·515 30·06	1·528 32·78	1·540 35·51	1·552 38·25	1·563 41·01	1·573 43·78	1·582 46·56	1·590 49·35	1·598 52·15
2·2	1·517 22·81	1·532 24·26	1·547 25·71	1·561 27·16	1·573 28·61	1·582 30·07	1·589 31·53	1·602 34·38	1·615 37·25	1·627 40·12	1·639 43·00	1·650 45·90	1·659 48·82	1·668 51·76	1·676 54·70
2·4	1·584 23·82	1·603 25·35	1·618 26·88	1·630 28·40	1·640 29·91	1·650 31·41	1·659 32·91	1·673 35·90	1·687 38·90	1·700 41·91	1·712 44·92	1·723 47·95	1·733 51·00	1·742 54·07	1·751 57·15
2·6	1·649 24·80	1·668 26·41	1·684 28·00	1·697 29·57	1·708 31·14	1·718 32·70	1·727 34·26	1·742 37·38	1·756 40·51	1·770 43·64	1·783 46·78	1·795 49·94	1·805 53·11	1·814 56·29	1·822 59·47
2·8	1·711 25·73	1·731 27·40	1·747 29·05	1·761 30·69	1·772 32·31	1·782 33·93	1·792 35·55	1·807 38·78	1·822 42·03	1·836 45·28	1·850 48·54	1·862 51·82	1·872 55·11	1·882 58·41	1·891 61·71
3·0	1·772 26·65	1·792 28·36	1·807 30·06	1·823 31·75	1·835 33·44	1·845 35·12	1·855 36·80	1·871 40·13	1·886 43·48	1·900 46·84	1·914 50·22	1·927 53·62	1·938 57·03	1·948 60·45	1·957 63·87

CLASS III. ($n = 0\cdot035$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 1·8.

For Bottom-Widths of

Fall per thousand.	9·0	9·5	10	11	12	13	14	15	16	17	18	19	20	21	22
0·05	0·259	0·261	0·263	0·267	0·270	0·273	0·275	0·277	0·279	0·281	0·283	0·285	0·287	0·288	0·289
	5·455	5·733	6·012	6·572	7·133	7·695	8·259	8·825	9·493	10·06	10·64	11·23	11·73	12·33	12·93
0·1	0·367	0·364	0·367	0·372	0·377	0·381	0·384	0·387	0·390	0·392	0·394	0·396	0·398	0·400	0·402
	7·603	7·996	8·389	9·175	9·961	10·75	11·53	12·32	13·10	13·89	14·68	15·47	16·26	17·05	17·84
0·2	0·508	0·511	0·514	0·520	0·526	0·531	0·536	0·540	0·544	0·547	0·550	0·553	0·556	0·558	0·560
	10·70	11·22	11·75	12·84	13·93	15·02	16·11	17·20	18·30	19·40	20·50	21·61	22·72	23·83	24·94
0·3	0·620	0·624	0·628	0·635	0·641	0·647	0·653	0·658	0·663	0·667	0·671	0·675	0·678	0·681	0·683
	13·05	13·70	14·35	15·67	16·99	18·31	19·63	20·96	22·30	23·65	25·00	26·35	27·70	29·05	30·40
0·4	0·713	0·718	0·723	0·731	0·739	0·746	0·752	0·758	0·763	0·768	0·772	0·776	0·779	0·782	0·784
	15·01	15·77	16·53	18·05	19·57	21·09	22·62	24·15	25·68	27·21	28·74	30·28	31·82	33·36	34·90
0·5	0·799	0·804	0·809	0·818	0·826	0·834	0·841	0·847	0·853	0·858	0·863	0·867	0·871	0·875	0·878
	16·83	17·66	18·49	20·18	21·88	23·58	25·28	26·98	28·69	30·41	32·13	33·85	35·58	37·31	39·04
0·6	0·875	0·881	0·886	0·896	0·905	0·913	0·921	0·928	0·934	0·940	0·945	0·950	0·954	0·958	0·962
	18·42	19·33	20·25	22·11	23·97	25·83	27·69	29·56	31·44	33·32	35·20	37·08	38·97	40·86	42·75
0·7	0·945	0·951	0·957	0·968	0·978	0·987	0·995	1·002	1·009	1·015	1·021	1·026	1·031	1·035	1·039
	19·90	20·89	21·88	23·88	25·89	27·90	29·91	31·92	33·94	35·97	38·01	40·06	42·13	44·19	46·25
0·8	1·010	1·017	1·023	1·035	1·045	1·055	1·064	1·072	1·079	1·085	1·091	1·097	1·102	1·107	1·111
	21·27	22·33	23·39	25·54	27·69	29·84	31·99	34·15	36·32	38·49	40·67	42·85	45·03	47·21	49·39

0·9	1·072 22·58	1·079 23·69	1·085 24·80	1·097 27·07	1·109 29·35	1·119 31·63	1·128 33·91	1·136 36·19	1·144 38·48	1·151 40·78	1·157 43·09	1·163 45·40	1·168 47·72	1·173 50·04	1·178 52·36
1·0	1·130 23·79	1·137 24·97	1·144 26·15	1·157 28·55	1·169 30·96	1·180 33·37	1·190 35·78	1·199 38·20	1·207 40·62	1·214 43·05	1·220 45·48	1·226 47·91	1·232 50·34	1·237 52·77	1·242 55·20
1·2	1·237 26·05	1·245 27·34	1·253 28·64	1·268 31·27	1·281 33·90	1·292 36·53	1·302 39·16	1·312 41·80	1·321 44·45	1·329 47·11	1·336 49·77	1·343 52·44	1·349 55·12	1·355 57·80	1·361 60·48
1·4	1·337 28·16	1·345 29·54	1·353 30·93	1·369 33·76	1·383 36·60	1·396 39·44	1·407 42·29	1·417 45·14	1·427 48·00	1·436 50·87	1·444 53·75	1·451 56·64	1·457 59·54	1·463 62·44	1·469 65·35
1·6	1·429 30·09	1·438 31·58	1·447 33·07	1·464 36·10	1·479 39·14	1·492 42·18	1·504 45·22	1·515 48·27	1·525 51·33	1·534 54·40	1·543 57·48	1·551 60·57	1·558 63·66	1·565 66·75	1·571 69·84
1·8	1·516 31·93	1·526 33·51	1·535 35·09	1·553 38·31	1·569 41·53	1·584 44·76	1·597 47·99	1·608 51·22	1·618 54·46	1·627 57·71	1·636 60·97	1·644 64·23	1·652 67·50	1·659 70·77	1·666 74·04
2·0	1·598 33·65	1·608 35·32	1·618 36·99	1·637 40·37	1·654 43·76	1·669 47·16	1·682 50·56	1·694 53·97	1·705 57·39	1·715 60·82	1·725 64·26	1·734 67·71	1·742 71·17	1·749 74·64	1·756 78·11
2·2	1·675 35·27	1·686 37·03	1·697 38·79	1·717 42·34	1·734 45·90	1·750 49·46	1·764 53·03	1·777 56·61	1·789 60·20	1·800 63·80	1·810 67·41	1·819 71·03	1·827 74·65	1·835 78·28	1·842 81·91
2·4	1·750 36·85	1·761 38·67	1·772 40·50	1·793 44·21	1·811 47·93	1·827 51·66	1·842 55·39	1·856 59·13	1·869 62·88	1·880 66·64	1·890 70·41	1·900 74·19	1·909 78·00	1·917 81·80	1·924 85·60
2·6	1·821 38·35	1·833 40·26	1·845 42·18	1·866 46·04	1·885 49·91	1·902 53·79	1·918 57·67	1·932 61·56	1·945 65·46	1·956 69·37	1·967 73·29	1·977 77·22	1·986 81·15	1·995 85·08	2·003 89·01
2·8	1·890 39·80	1·902 41·77	1·914 43·75	1·936 47·76	1·956 51·78	1·974 55·81	1·990 59·84	2·005 63·88	2·018 67·93	2·030 71·99	2·041 76·06	2·051 80·13	2·061 84·21	2·070 88·29	2·078 92·37
3·0	1·957 41·21	1·970 43·26	1·982 45·31	2·005 49·45	2·025 53·60	2·043 57·76	2·060 61·93	2·075 66·11	2·089 70·30	2·101 74·50	2·112 78·71	2·122 82·91	2·132 87·11	2·142 91·31	2·151 95·51

CLASS III. ($n = 0\cdot035$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 2·0.

For Bottom-Widths of

Fall per thousand.	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
0·05	0·290 8·700	0·293 9·384	0·296 10·07	0·299 10·75	0·301 11·43	0·303 12·12	0·305 12·81	0·307 13·50	0·309 14·20	0·311 14·90	0·312 15·60	0·313 16·29	0·315 16·99	0·316 17·69	0·317 18·39
0·1	0·402 12·06	0·406 13·00	0·410 13·95	0·414 14·90	0·417 15·85	0·420 16·80	0·423 17·76	0·426 18·72	0·428 19·68	0·430 20·64	0·432 21·60	0·434 22·57	0·436 23·55	0·438 24·53	0·440 25·52
0·2	0·560 16·82	0·566 18·13	0·571 19·44	0·576 20·75	0·581 22·06	0·585 23·38	0·588 24·69	0·591 26·00	0·594 27·31	0·597 28·63	0·599 29·95	0·601 31·26	0·603 32·57	0·605 33·89	0·607 35·21
0·3	0·684 20·52	0·691 22·12	0·698 23·72	0·704 25·32	0·709 26·93	0·714 28·54	0·718 30·14	0·722 31·75	0·725 33·36	0·728 34·97	0·731 36·50	0·734 38·20	0·738 39·84	0·741 41·49	0·744 43·15
0·4	0·790 23·70	0·797 25·51	0·803 27·33	0·809 29·16	0·815 30·99	0·820 32·83	0·825 34·68	0·830 36·53	0·835 38·38	0·839 40·23	0·842 42·08	0·845 43·94	0·848 45·80	0·851 47·66	0·854 49·53
0·5	0·879 26·37	0·887 28·41	0·895 30·45	0·902 32·50	0·909 34·55	0·915 36·60	0·920 38·66	0·925 40·72	0·930 42·78	0·934 44·84	0·938 46·90	0·942 48·96	0·945 51·02	0·948 53·09	0·951 55·16
0·6	0·963 28·89	0·972 31·13	0·981 33·37	0·989 35·62	0·996 37·87	1·003 40·12	1·009 42·37	1·014 44·62	1·019 46·87	1·023 49·12	1·027 51·38	1·031 53·65	1·035 55·93	1·039 58·21	1·043 60·49
0·7	1·040 31·20	1·050 33·60	1·059 36·01	1·067 38·43	1·075 40·85	1·082 43·28	1·088 45·72	1·094 48·16	1·100 50·60	1·105 53·05	1·110 55·50	1·114 57·95	1·118 60·40	1·122 62·85	1·126 65·31
0·8	1·112 33·36	1·122 35·94	1·132 38·52	1·141 41·10	1·149 43·69	1·157 46·28	1·164 48·88	1·170 51·48	1·176 54·08	1·181 56·69	1·186 59·30	1·191 61·91	1·195 64·53	1·199 67·15	1·203 69·77

0·9	1·180 35·40	1·191 38·12	1·201 40·85	1·210 43·59	1·219 46·33	1·227 49·08	1·234 51·84	1·241 54·60	1·247 57·36	1·253 60·13	1·258 62·90	1·263 65·67	1·268 68·45	1·272 71·23	1·276 74·01
1·0	1·243 37·29	1·255 40·16	1·266 43·04	1·276 45·93	1·285 48·82	1·293 51·72	1·301 54·63	1·308 57·54	1·314 60·46	1·320 63·38	1·326 66·30	1·331 69·23	1·336 72·17	1·341 75·12	1·346 78·07
1·2	1·362 40·86	1·375 44·01	1·387 47·17	1·398 50·33	1·408 53·50	1·417 56·68	1·425 59·87	1·433 63·06	1·440 66·25	1·447 69·45	1·453 72·65	1·459 75·86	1·464 79·07	1·469 82·28	1·474 85·49
1·4	1·471 44·13	1·485 47·53	1·498 50·94	1·510 54·35	1·520 57·77	1·530 61·20	1·539 64·64	1·548 68·09	1·556 71·54	1·563 74·99	1·569 78·45	1·575 81·92	1·581 85·39	1·587 88·86	1·592 92·34
1·6	1·573 47·19	1·588 50·82	1·602 54·46	1·615 58·11	1·626 61·77	1·636 65·44	1·646 69·12	1·655 72·80	1·663 76·48	1·670 80·16	1·677 83·85	1·684 87·55	1·690 91·26	1·696 94·99	1·702 98·72
1·8	1·668 50·04	1·685 53·90	1·699 57·77	1·712 61·64	1·724 65·52	1·735 69·40	1·745 73·29	1·755 77·19	1·764 81·10	1·772 85·02	1·779 88·95	1·786 92·88	1·793 96·82	1·799 100·7	1·805 104·7
2·0	1·758 52·74	1·776 56·82	1·791 60·91	1·805 65·00	1·818 69·10	1·830 73·20	1·840 77·31	1·850 81·42	1·859 85·53	1·867 89·64	1·875 93·75	1·883 97·87	1·890 102·1	1·897 106·2	1·903 110·4
2·2	1·844 55·32	1·862 59·60	1·878 63·89	1·893 68·19	1·907 72·50	1·920 76·80	1·931 81·11	1·941 85·42	1·950 89·73	1·959 94·04	1·967 98·35	1·975 102·7	1·982 107·0	1·989 111·4	1·996 115·8
2·4	1·926 57·78	1·945 62·24	1·962 66·71	1·977 71·19	1·991 75·67	2·004 80·16	2·016 84·65	2·026 89·15	2·036 93·66	2·045 98·17	2·054 102·7	2·062 107·2	2·070 111·7	2·077 116·3	2·084 120·9
2·6	2·005 60·15	2·025 64·78	2·042 69·42	2·058 74·07	2·072 78·73	2·085 83·40	2·097 88·09	2·109 92·79	2·120 97·40	2·130 102·1	2·139 106·9	2·147 111·6	2·155 116·3	2·163 121·1	2·170 125·9
2·8	2·080 62·40	2·101 67·22	2·119 72·05	2·135 76·88	2·150 81·72	2·164 86·56	2·177 91·41	2·189 96·27	2·200 101·2	2·210 106·0	2·219 110·9	2·228 115·8	2·236 120·7	2·244 125·6	2·251 130·5
3·0	2·154 64·62	2·175 69·60	2·193 74·59	2·210 79·58	2·226 84·58	2·240 89·60	2·253 94·65	2·265 99·70	2·276 104·7	2·287 109·7	2·297 114·8	2·306 119·8	2·314 124·9	2·322 130·0	2·330 135·1

CLASS III. ($n = 0·035$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 2·2.

For Bottom-Widths of

Fall per thousand.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0·05	0·320 13·59	0·322 14·40	0·324 15·21	0·326 16·02	0·328 16·84	0·330 17·66	0·332 18·49	0·334 19·32	0·336 20·15	0·338 20·98	0·339 21·82	0·340 22·65	0·341 23·48	0·342 24·31	0·343 25·14
0·1	0·442 18·77	0·446 19·90	0·450 21·03	0·453 22·16	0·455 23·29	0·457 24·43	0·459 25·56	0·461 26·69	0·463 27·83	0·465 28·97	0·467 30·10	0·469 31·23	0·470 32·35	0·471 33·47	0·472 34·58
0·2	0·613 26·02	0·618 27·57	0·622 29·12	0·626 30·67	0·629 32·22	0·632 33·78	0·635 35·35	0·638 36·92	0·641 38·50	0·644 40·08	0·647 41·66	0·649 43·23	0·651 44·79	0·653 46·35	0·654 47·91
0·3	0·746 31·67	0·752 33·56	0·757 35·46	0·762 37·36	0·766 39·26	0·770 41·16	0·774 43·07	0·778 44·98	0·781 46·90	0·784 48·82	0·787 50·73	0·790 52·63	0·792 54·53	0·794 56·43	0·796 58·32
0·4	0·861 36·56	0·867 38·73	0·872 40·90	0·877 43·07	0·882 45·24	0·887 47·42	0·891 49·60	0·895 51·78	0·899 53·96	0·902 56·14	0·905 58·33	0·908 60·53	0·911 62·74	0·914 64·95	0·917 67·17
0·5	0·959 40·72	0·966 43·14	0·972 45·56	0·978 47·98	0·983 50·40	0·988 52·82	0·992 55·25	0·996 57·68	1·000 60·11	1·004 62·54	1·008 64·97	1·011 67·41	1·014 69·85	1·017 72·29	1·020 74·73
0·6	1·051 44·52	1·058 47·18	1·065 49·84	1·071 52·50	1·077 55·17	1·082 57·84	1·087 60·50	1·092 63·16	1·096 65·83	1·100 68·50	1·104 71·17	1·108 73·83	1·111 76·50	1·114 79·16	1·117 81·83
0·7	1·135 48·19	1·143 51·04	1·150 53·90	1·157 56·76	1·163 59·62	1·169 62·49	1·174 65·37	1·179 68·25	1·184 71·13	1·189 74·01	1·193 76·90	1·197 79·78	1·201 82·66	1·204 85·54	1·207 88·43
0·8	1·213 51·50	1·221 54·56	1·229 57·62	1·237 60·68	1·244 63·75	1·250 66·82	1·256 69·89	1·261 72·96	1·266 76·03	1·271 79·11	1·275 82·19	1·279 85·27	1·283 88·35	1·287 91·43	1·290 94·51

0·9	1·287 54·65	1·296 57·89	1·304 61·14	1·312 64·39	1·319 67·64	1·326 70·89	1·332 74·14	1·337 77·39	1·342 80·64	1·347 83·90	1·352 87·16	1·357 90·42	1·361 93·68	1·365 96·94	1·368 100·2
1·0	1·357 57·62	1·366 61·03	1·375 64·44	1·383 67·85	1·390 71·26	1·397 74·68	1·403 78·11	1·409 81·54	1·415 84·97	1·420 88·41	1·425 91·85	1·430 95·30	1·435 98·76	1·439 102·2	1·443 105·7
1·2	1·486 63·10	1·496 66·84	1·506 70·59	1·515 74·34	1·523 78·09	1·531 81·85	1·538 85·61	1·544 89·38	1·550 93·15	1·556 96·92	1·561 100·7	1·566 104·5	1·571 108·3	1·576 112·1	1·581 115·8
1·4	1·605 68·16	1·616 72·19	1·626 76·23	1·636 80·27	1·645 84·32	1·653 88·37	1·660 92·43	1·667 96·49	1·674 100·6	1·681 104·6	1·687 108·7	1·692 112·7	1·697 116·8	1·702 120·9	1·707 125·0
1·6	1·716 72·86	1·728 77·20	1·739 81·54	1·750 85·88	1·760 90·23	1·769 94·58	1·777 99·02	1·784 103·3	1·791 107·6	1·797 111·9	1·803 116·3	1·809 120·6	1·814 124·9	1·819 129·3	1·824 133·7
1·8	1·820 77·27	1·833 81·85	1·844 86·43	1·855 91·02	1·865 95·61	1·874 100·2	1·883 104·8	1·891 109·4	1·899 114·0	1·906 118·6	1·913 123·2	1·919 127·8	1·925 132·4	1·930 137·0	1·935 141·7
2·0	1·918 81·43	1·931 86·25	1·944 91·08	1·956 95·92	1·966 100·7	1·976 105·6	1·985 110·4	1·993 115·2	2·001 120·1	2·008 125·0	2·015 129·9	2·022 134·7	2·028 139·6	2·034 144·5	2·040 149·4
2·2	2·012 85·43	2·026 90·50	2·039 95·57	2·051 100·6	2·062 105·7	2·072 110·8	2·082 115·9	2·091 121·0	2·099 126·1	2·107 131·2	2·114 136·3	2·121 141·4	2·127 146·5	2·133 151·6	2·139 156·7
2·4	2·101 89·21	2·116 94·51	2·130 99·81	2·143 105·1	2·155 110·4	2·165 115·7	2·174 121·0	2·183 126·3	2·192 131·6	2·200 136·9	2·208 142·3	2·215 147·6	2·222 153·0	2·228 158·3	2·234 163·7
2·6	2·187 92·85	2·202 98·40	2·216 103·9	2·230 109·5	2·243 115·0	2·254 120·6	2·264 126·1	2·273 131·6	2·282 137·1	2·290 142·6	2·298 148·1	2·306 153·6	2·313 159·2	2·319 164·7	2·325 170·3
2·8	2·270 96·38	2·286 102·1	2·301 107·8	2·315 113·5	2·328 119·2	2·339 125·0	2·349 130·7	2·359 136·4	2·368 142·1	2·377 147·9	2·385 153·7	2·393 159·4	2·400 165·2	2·407 170·9	2·413 176·7
3·0	2·350 99·77	2·367 105·7	2·382 111·6	2·396 117·5	2·409 123·4	2·420 129·4	2·431 135·3	2·441 141·2	2·451 147·1	2·460 153·1	2·469 159·1	2·477 165·0	2·484 171·0	2·491 177·0	2·498 183·0

CLASS III. ($n = 0{\cdot}035$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 2·4.

For Bottom-Widths of

Fall per thousand.	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
0·05	0·349 19·76	0·351 20·72	0·353 21·69	0·355 22·66	0·357 23·63	0·359 24·60	0·361 25·56	0·362 26·53	0·363 27·50	0·364 28·47	0·365 29·44	0·366 30·41	0·367 31·38	0·368 32·35	0·369 33·31
0·1	0·480 27·19	0·483 28·50	0·486 29·81	0·488 31·13	0·490 32·45	0·492 33·77	0·494 35·10	0·496 36·44	0·498 37·78	0·500 39·11	0·502 40·44	0·503 41·76	0·504 43·06	0·505 44·36	0·506 45·65
0·2	0·666 37·89	0·669 39·64	0·672 41·40	0·675 43·17	0·678 44·95	0·681 46·74	0·683 48·55	0·686 50·36	0·688 52·17	0·690 53·99	0·692 55·81	0·694 57·62	0·696 59·44	0·698 61·26	0·699 63·08
0·3	0·810 45·87	0·814 48·08	0·818 50·29	0·822 52·50	0·826 54·70	0·829 56·90	0·832 59·10	0·835 61·30	0·838 63·50	0·840 65·70	0·842 67·90	0·844 70·09	0·846 72·27	0·848 74·44	0·849 76·61
0·4	0·930 52·67	0·935 55·19	0·940 57·71	0·944 60·23	0·948 62·75	0·951 65·28	0·954 67·80	0·957 70·32	0·960 72·84	0·963 75·37	0·966 77·90	0·969 80·44	0·972 83·00	0·975 85·58	0·977 88·17
0·5	1·037 58·73	1·042 61·52	1·047 64·32	1·052 67·12	1·056 69·93	1·060 72·76	1·064 75·59	1·068 78·42	1·072 81·25	1·075 84·08	1·078 86·92	1·081 89·76	1·084 92·59	1·087 95·43	1·089 98·27
0·6	1·136 64·34	1·142 67·42	1·147 70·50	1·152 73·58	1·157 76·67	1·162 79·76	1·166 82·85	1·170 85·94	1·174 89·04	1·178 92·14	1·181 95·24	1·184 98·33	1·187 101·4	1·190 104·5	1·193 107·6
0·7	1·227 69·50	1·233 72·80	1·239 76·11	1·244 79·42	1·249 82·74	1·254 86·08	1·259 89·42	1·263 92·76	1·267 96·10	1·271 99·45	1·275 102·8	1·279 106·1	1·282 109·4	1·285 112·8	1·288 116·2
0·8	1·312 74·32	1·318 77·85	1·324 81·39	1·330 84·93	1·336 88·48	1·341 92·04	1·346 95·61	1·351 99·18	1·355 102·8	1·359 106·3	1·363 109·9	1·367 113·4	1·371 117·0	1·374 120·6	1·377 124·2

0·9	1·391 78·78	1·398 82·56	1·405 86·34	1·411 90·12	1·417 93·90	1·423 97·68	1·428 101·5	1·433 105·3	1·438 109·1	1·442 112·8	1·446 116·6	1·450 120·4	1·454 124·2	1·458 128·0	1·461 131·8
1·0	1·467 83·08	1·474 87·03	1·481 90·99	1·487 94·95	1·493 98·92	1·499 102·9	1·505 106·9	1·510 110·9	1·515 114·9	1·520 118·9	1·525 122·9	1·529 126·9	1·533 130·9	1·537 134·9	1·540 138·9
1·2	1·607 91·01	1·615 95·37	1·622 99·73	1·629 104·0	1·636 108·4	1·643 112·8	1·649 117·1	1·654 121·4	1·659 125·8	1·664 130·2	1·669 134·6	1·674 139·0	1·679 143·4	1·683 147·8	1·687 152·2
1·4	1·735 98·27	1·744 103·0	1·752 107·6	1·760 112·3	1·767 117·0	1·774 121·7	1·781 126·4	1·787 131·1	1·793 135·9	1·799 140·7	1·804 145·5	1·809 150·3	1·814 155·0	1·818 159·7	1·822 164·4
1·6	1·855 105·1	1·864 110·1	1·873 115·1	1·881 120·1	1·889 125·1	1·897 130·2	1·904 135·2	1·910 140·2	1·916 145·3	1·922 150·4	1·928 155·5	1·933 160·6	1·938 165·7	1·943 170·8	1·948 175·8
1·8	1·968 111·4	1·978 116·7	1·987 122·0	1·996 127·3	2·004 132·7	2·012 138·1	2·019 143·4	2·026 148·7	2·033 154·1	2·039 159·5	2·045 164·9	2·051 170·2	2·056 175·6	2·061 181·0	2·066 186·4
2·0	2·074 117·4	2·084 123·0	2·094 128·6	2·103 134·2	2·112 139·8	2·120 145·5	2·128 151·1	2·135 156·7	2·142 162·4	2·149 168·1	2·156 173·8	2·162 179·4	2·167 185·1	2·172 190·8	2·177 196·5
2·2	2·175 123·2	2·186 129·0	2·196 134·9	2·206 140·8	2·215 146·7	2·224 152·6	2·232 158·5	2·240 164·4	2·247 170·3	2·254 176·3	2·261 182·3	2·267 188·2	2·273 194·2	2·279 200·2	2·284 206·2
2·4	2·272 128·7	2·283 134·8	2·294 140·9	2·304 147·0	2·313 153·1	2·322 159·3	2·331 165·5	2·339 171·7	2·347 177·9	2·354 184·1	2·361 190·3	2·368 196·5	2·374 202·7	2·380 208·9	2·385 215·2
2·6	2·364 133·9	2·376 140·3	2·387 146·7	2·397 153·1	2·407 159·5	2·417 165·9	2·426 172·3	2·434 178·7	2·442 185·2	2·450 191·7	2·458 198·2	2·465 204·6	2·471 211·1	2·477 217·6	2·483 224·1
2·8	2·454 139·0	2·466 145·6	2·478 152·2	2·489 158·8	2·499 165·5	2·509 172·2	2·518 178·8	2·527 185·5	2·535 192·2	2·543 198·9	2·550 205·6	2·557 212·3	2·564 219·0	2·570 225·7	2·576 232·4
3·0	2·540 143·9	2·553 150·7	2·565 157·5	2·576 164·4	2·587 171·3	2·597 178·2	2·607 185·1	2·616 192·0	2·624 198·9	2·632 205·9	2·640 212·9	2·647 219·8	2·654 226·7	2·661 233·6	2·667 240·6

CLASS III. (n = 0·035.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 2·6.

For Bottom-Widths of

Fall per thousand.	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
0·05	0·380 29·54	0·382 30·65	0·384 31·76	0·385 32·87	0·386 33·98	0·387 35·10	0·388 36·21	0·389 37·32	0·390 38·44	0·391 39·56	0·392 40·68	0·393 41·80	0·394 42·93	0·395 44·06	0·396 45·19
0·1	0·520 40·42	0·522 41·93	0·524 43·44	0·526 44·96	0·528 46·48	0·529 48·00	0·530 49·52	0·532 51·05	0·533 52·59	0·535 54·13	0·536 55·66	0·537 57·18	0·539 58·70	0·540 60·22	0·541 61·74
0·2	0·721 56·05	0·724 58·12	0·726 60·20	0·728 62·28	0·730 64·36	0·732 66·44	0·734 68·52	0·736 70·60	0·737 72·68	0·739 74·76	0·741 76·84	0·743 78·92	0·744 81·00	0·745 82·09	0·746 85·18
0·3	0·873 67·87	0·876 70·37	0·879 72·87	0·882 75·38	0·884 77·89	0·886 80·40	0·888 82·92	0·890 85·45	0·892 87·98	0·895 90·51	0·897 93·04	0·899 95·58	0·901 98·12	0·902 100·6	0·903 103·2
0·4	1·005 78·13	1·008 81·01	1·011 83·89	1·014 86·78	1·017 89·67	1·020 92·56	1·023 95·44	1·026 98·33	1·028 101·2	1·031 104·1	1·033 107·0	1·035 109·9	1·037 112·8	1·039 115·7	1·040 118·7
0·5	1·120 87·08	1·124 90·30	1·128 93·52	1·131 96·74	1·134 100·0	1·137 103·2	1·140 106·4	1·143 109·6	1·146 112·8	1·149 116·0	1·151 119·3	1·153 122·5	1·155 125·7	1·157 129·0	1·159 132·3
0·6	1·227 95·39	1·231 98·89	1·235 102·4	1·239 105·9	1·242 109·5	1·245 112·9	1·248 116·4	1·251 119·9	1·254 123·4	1·257 127·0	1·260 130·6	1·263 134·1	1·265 137·7	1·267 141·3	1·269 144·9
0·7	1·325 103·0	1·329 106·7	1·333 110·5	1·337 114·3	1·341 118·1	1·345 121·9	1·349 125·8	1·352 129·6	1·355 133·4	1·357 137·2	1·359 141·0	1·361 144·8	1·363 148·5	1·365 152·2	1·366 155·9
0·8	1·416 110·1	1·421 114·1	1·426 118·1	1·430 122·2	1·434 126·3	1·438 130·4	1·441 134·4	1·444 138·4	1·447 142·5	1·450 146·6	1·453 150·7	1·456 154·7	1·459 158·8	1·461 162·9	1·463 167·0

0·9	1·502 116·7	1·507 121·1	1·512 125·4	1·516 129·7	1·520 134·0	1·524 138·3	1·528 142·6	1·531 146·9	1·534 151·2	1·537 155·5	1·540 159·8	1·543 164·1	1·546 168·4	1·549 172·7	1·551 177·0
1·0	1·583 123·0	1·589 127·5	1·594 132·0	1·599 136·5	1·603 141·1	1·607 145·7	1·611 150·2	1·614 154·7	1·617 159·2	1·621 163·8	1·624 168·4	1·627 172·9	1·630 177·4	1·633 182·0	1·635 186·6
1·2	1·734 134·8	1·740 139·7	1·746 144·6	1·751 149·6	1·756 154·6	1·760 159·6	1·764 164·6	1·768 169·6	1·772 174·6	1·776 179·6	1·779 184·5	1·782 189·5	1·785 194·5	1·788 199·5	1·791 204·4
1·4	1·873 145·6	1·879 151·0	1·885 156·4	1·891 161·8	1·896 167·2	1·901 172·5	1·906 177·9	1·910 183·3	1·914 188·7	1·918 194·1	1·922 199·4	1·926 204·8	1·929 210·2	1·932 215·6	1·935 220·9
1·6	2·003 155·7	2·010 161·4	2·016 167·1	2·022 172·8	2·027 178·5	2·032 184·3	2·037 190·0	2·042 195·7	2·046 201·4	2·050 207·2	2·054 213·0	2·058 218·7	2·062 224·4	2·065 230·2	2·068 236·0
1·8	2·124 165·1	2·131 171·1	2·138 177·2	2·144 183·3	2·150 189·4	2·155 195·5	2·160 201·6	2·165 207·7	2·170 213·8	2·175 219·9	2·179 226·0	2·183 232·1	2·187 238·2	2·190 244·3	2·193 250·4
2·0	2·239 174·0	2·247 180·4	2·254 186·8	2·260 193·2	2·266 199·6	2·272 206·1	2·277 212·5	2·282 218·9	2·287 225·3	2·292 231·8	2·297 238·3	2·301 244·7	2·305 251·1	2·309 257·5	2·312 263·9
2·2	2·348 182·5	2·356 189·2	2·363 195·9	2·370 202·6	2·376 209·4	2·382 216·2	2·388 222·9	2·394 229·6	2·399 236·3	2·404 243·1	2·409 249·9	2·413 256·6	2·417 263·3	2·421 270·0	2·425 276·7
2·4	2·452 190·6	2·461 197·7	2·469 204·8	2·476 211·8	2·483 218·8	2·489 225·8	2·495 232·9	2·501 240·0	2·506 247·0	2·511 254·0	2·516 261·0	2·521 268·0	2·525 275·0	2·529 282·0	2·533 289·0
2·6	2·553 198·4	2·562 205·7	2·570 213·0	2·577 220·3	2·584 227·6	2·590 235·0	2·596 242·3	2·602 249·6	2·608 256·9	2·613 264·2	2·618 271·6	2·623 278·9	2·628 286·2	2·632 293·5	2·636 300·9
2·8	2·649 205·9	2·658 213·5	2·666 221·1	2·674 228·7	2·681 236·3	2·688 243·9	2·694 251·5	2·700 259·1	2·706 266·7	2·712 274·3	2·717 281·9	2·722 289·5	2·727 297·1	2·732 304·7	2·736 312·3
3·0	2·742 213·1	2·751 220·9	2·760 228·7	2·768 236·6	2·775 244·5	2·782 252·4	2·789 260·2	2·795 268·0	2·801 275·9	2·807 283·8	2·813 291·7	2·818 299·5	2·823 307·4	2·828 315·3	2·832 323·2

CLASS III. (n = 0·035.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 2·8.

For Bottom-Widths of

Fall per thousand.	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
0·05	0·411 43·96	0·412 45·23	0·413 46·50	0·414 47·77	0·415 49·04	0·416 50·31	0·417 51·59	0·418 52·87	0·419 54·15	0·420 55·43	0·421 56·72	0·421 57·99	0·422 59·25	0·422 60·51	0·422 61·77
0·1	0·560 59·90	0·562 61·61	0·563 63·32	0·564 65·03	0·565 66·75	0·566 68·47	0·567 70·18	0·568 71·89	0·569 73·61	0·570 75·33	0·571 77·05	0·572 78·78	0·573 80·52	0·574 82·26	0·575 84·00
0·2	0·773 82·68	0·775 85·01	0·776 87·34	0·777 89·67	0·779 92·00	0·780 94·34	0·781 96·68	0·783 99·03	0·784 101·3	0·785 103·7	0·787 106·1	0·788 108·4	0·789 110·7	0·790 113·1	0·791 115·5
0·3	0·936 100·1	0·938 102·9	0·940 105·7	0·941 108·5	0·943 111·4	0·945 114·3	0·947 117·1	0·949 120·0	0·951 122·9	0·952 125·8	0·954 128·7	0·956 131·6	0·957 134·5	0·959 137·4	0·960 140·3
0·4	1·077 115·2	1·080 118·4	1·082 121·7	1·084 125·0	1·086 128·3	1·088 131·6	1·090 134·8	1·092 138·1	1·094 141·4	1·095 144·7	1·097 148·0	1·099 151·3	1·101 154·7	1·103 158·1	1·105 161·5
0·5	1·201 128·5	1·203 132·1	1·205 135·7	1·207 139·3	1·209 142·9	1·211 146·5	1·213 150·1	1·215 153·7	1·217 157·4	1·219 161·1	1·221 164·8	1·223 168·5	1·225 172·2	1·227 175·9	1·229 179·6
0·6	1·308 139·9	1·311 143·9	1·314 147·9	1·317 151·9	1·320 155·9	1·322 159·9	1·325 163·9	1·328 167·9	1·330 171·9	1·332 175·9	1·334 180·0	1·336 184·0	1·338 188·0	1·340 192·0	1·342 196·1
0·7	1·413 151·1	1·416 155·4	1·419 159·7	1·422 164·0	1·425 168·3	1·428 172·7	1·431 177·0	1·434 181·3	1·437 185·7	1·439 190·1	1·442 194·5	1·444 198·8	1·446 203·1	1·448 207·5	1·450 211·9
0·8	1·509 161·4	1·512 165·9	1·515 170·5	1·518 175·1	1·521 179·7	1·524 184·3	1·527 188·9	1·530 193·5	1·532 198·1	1·535 202·7	1·537 207·4	1·539 212·0	1·541 216·6	1·543 221·2	1·545 225·8

0·9	1·600 171·1	1·604 175·9	1·607 180·8	1·610 185·7	1·613 190·6	1·616 195·5	1·619 200·4	1·622 205·3	1·625 210·2	1·628 215·1	1·630 220·0	1·632 224·9	1·634 229·8	1·636 234·6	1·638 239·4
1·0	1·686 180·3	1·690 185·4	1·694 190·5	1·698 195·6	1·701 200·8	1·704 206·0	1·707 211·1	1·710 216·2	1·713 221·3	1·716 226·5	1·718 231·7	1·720 236·8	1·722 241·9	1·724 247·1	1·726 252·3
1·2	1·848 197·6	1·852 203·2	1·856 208·8	1·860 214·4	1·864 220·1	1·867 225·8	1·870 231·4	1·873 237·0	1·876 242·6	1·879 248·3	1·882 254·0	1·885 259·6	1·887 265·2	1·890 270·8	1·892 276·5
1·4	1·996 213·5	2·000 219·5	2·005 225·6	2·009 231·7	2·013 237·8	2·017 243·9	2·021 249·9	2·024 256·0	2·027 262·1	2·030 268·2	2·033 274·3	2·036 280·3	2·038 286·3	2·040 292·3	2·042 298·4
1·6	2·134 228·2	2·139 234·7	2·143 241·2	2·147 247·7	2·151 254·2	2·155 260·7	2·159 267·2	2·163 273·7	2·167 280·2	2·170 286·7	2·173 293·3	2·176 299·8	2·179 306·3	2·182 312·8	2·185 319·3
1·8	2·263 242·0	2·268 248·8	2·273 255·7	2·278 262·6	2·282 269·5	2·286 276·4	2·290 283·3	2·294 290·2	2·298 297·1	2·301 304·0	2·304 310·9	2·307 317·8	2·310 324·7	2·313 331·6	2·316 338·5
2·0	2·385 255·1	2·390 262·3	2·395 269·5	2·400 276·8	2·405 284·1	2·409 291·4	2·413 298·6	2·417 305·9	2·421 313·2	2·425 320·5	2·429 327·8	2·433 335·1	2·437 342·4	2·440 349·7	2·443 357·1
2·2	2·505 267·9	2·510 275·4	2·515 283·0	2·520 290·6	2·524 298·2	2·528 305·8	2·532 313·4	2·536 321·0	2·540 328·6	2·544 336·2	2·548 343·8	2·551 351·4	2·554 359·0	2·557 366·6	2·560 374·2
2·4	2·613 279·5	2·619 287·4	2·625 295·3	2·630 303·3	2·635 311·3	2·640 319·3	2·645 327·2	2·649 335·1	2·653 343·1	2·657 351·1	2·661 359·1	2·665 367·0	2·668 374·9	2·671 382·9	2·674 390·9
2·6	2·720 290·9	2·726 299·1	2·732 307·4	2·737 315·7	2·742 324·0	2·747 332·3	2·752 340·5	2·757 348·8	2·762 357·1	2·766 365·4	2·770 373·7	2·774 381·9	2·777 390·2	2·780 398·4	2·783 406·7

CLASS III. ($n = 0 \cdot 035$.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 3·0.

For Bottom-Widths of

Fall per thousand.	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
0·05	0·424	0·425	0·426	0·427	0·428	0·429	0·430	0·431	0·432	0·433	0·434	0·435	0·435	0·436	0·436
	54·70	56·11	57·52	58·93	60·35	61·77	63·22	64·67	66·12	67·57	69·01	70·36	71·71	73·05	74·39
0·1	0·577	0·579	0·580	0·581	0·583	0·584	0·585	0·586	0·587	0·588	0·589	0·590	0·591	0·592	0·593
	74·44	76·38	78·31	80·24	82·17	84·10	86·02	87·93	89·84	91·75	93·65	95·54	97·43	99·32	101·2
0·2	0·794	0·796	0·798	0·800	0·802	0·804	0·805	0·807	0·808	0·809	0·811	0·812	0·813	0·814	0·815
	102·4	105·1	107·8	110·5	113·2	115·8	118·5	121·1	123·7	126·3	128·9	131·5	134·0	136·5	139·0
0·3	0·962	0·965	0·967	0·969	0·971	0·973	0·975	0·977	0·979	0·980	0·982	0·984	0·985	0·987	0·988
	124·1	127·3	130·5	133·7	136·9	140·1	143·3	146·5	149·7	152·9	156·1	159·3	162·4	165·5	168·6
0·4	1·108	1·111	1·113	1·115	1·118	1·121	1·123	1·125	1·127	1·129	1·131	1·133	1·134	1·136	1·138
	142·9	146·6	150·3	154·0	157·7	161·4	165·1	168·8	172·5	176·2	179·8	183·4	187·0	190·6	194·1
0·5	1·235	1·238	1·241	1·244	1·247	1·249	1·251	1·254	1·256	1·258	1·260	1·262	1·264	1·266	1·268
	159·3	163·4	167·5	171·6	175·7	179·8	183·9	188·0	192·1	196·2	200·3	204·3	208·3	212·3	216·3
0·6	1·346	1·349	1·352	1·355	1·358	1·361	1·364	1·367	1·370	1·373	1·376	1·379	1·381	1·383	1·385
	173·6	178·0	182·5	187·0	191·5	196·0	200·6	205·2	209·7	214·2	218·7	223·1	227·5	231·9	236·3
0·7	1·454	1·458	1·461	1·464	1·467	1·470	1·473	1·476	1·478	1·480	1·483	1·485	1·487	1·489	1·491
	187·6	192·5	197·3	202·1	206·9	211·7	216·5	221·3	226·1	230·9	235·7	240·4	245·1	249·8	254·5
0·8	1·555	1·559	1·562	1·565	1·568	1·571	1·574	1·577	1·580	1·582	1·585	1·588	1·590	1·593	1·595
	200·6	205·8	210·9	216·0	221·1	226·2	231·4	236·6	241·8	246·9	252·0	257·1	262·1	267·1	272·1

0·9	1·649 212·7	1·653 218·2	1·657 223·7	1·660 229·2	1·664 234·6	1·667 240·0	1·670 245·5	1·673 251·0	1·676 256·5	1·679 262·0	1·682 267·4	1·685 272·8	1·687 278·1	1·690 283·4	1·692 288·7
1·0	1·739 224·3	1·743 230·1	1·747 235·9	1·750 241·6	1·754 247·3	1·757 253·0	1·760 258·8	1·763 264·6	1·766 270·3	1·769 276·0	1·772 281·7	1·775 287·4	1·778 293·0	1·781 298·6	1·783 304·2
1·2	1·904 245·6	1·909 251·9	1·913 258·2	1·917 264·5	1·921 270·8	1·924 277·1	1·928 283·4	1·932 289·7	1·935 296·0	1·938 302·3	1·941 308·6	1·944 314·8	1·947 321·0	1·950 327·1	1·953 333·2
1·4	2·057 265·3	2·061 272·1	2·065 278·9	2·069 285·7	2·073 292·4	2·077 299·1	2·081 306·6	2·085 312·9	2·089 319·8	2·093 326·6	2·097 333·4	2·100 340·1	2·103 346·8	2·107 353·4	2·110 360·0
1·6	2·199 283·6	2·204 290·9	2·209 298·2	2·213 305·5	2·218 312·8	2·222 320·0	2·226 327·3	2·230 334·6	2·234 341·9	2·238 349·2	2·242 356·4	2·245 363·5	2·248 370·6	2·251 377·6	2·254 384·6
1·8	2·332 300·8	2·337 308·6	2·342 316·3	2·347 324·0	2·352 331·7	2·357 339·4	2·361 347·1	2·365 354·8	2·369 362·5	2·373 370·2	2·377 377·9	2·381 385·5	2·385 393·1	2·389 400·7	2·393 408·2
2·0	2·458 317·1	2·464 325·2	2·469 333·3	2·474 341·4	2·479 349·5	2·484 357·7	2·489 365·9	2·494 374·1	2·498 382·2	2·502 390·3	2·506 398·4	2·510 406·4	2·514 414·4	2·518 422·4	2·523 430·4
2·2	2·579 332·7	2·585 341·2	2·591 349·7	2·596 358·2	2·601 366·7	2·606 375·2	2·611 383·8	2·616 392·4	2·620 401·0	2·624 409·5	2·629 418·0	2·633 426·4	2·637 434·7	2·641 443·0	2·645 451·2

CLASS III. (n = 0·035.)

Mean Velocities and Quantities of Discharge per second.

For a Depth of Water of 3·5.

For Bottom-Widths of

Fall per thousand.	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72
0·05	0·488	0·490	0·492	0·493	0·495	0·496	0·497	0·499	0·500	0·501	0·502	0·503	0·504	0·505	0·506
	84·12	87·85	91·58	95·31	99·05	102·8	106·5	110·2	114·0	117·8	121·6	125·4	129·2	133·0	136·8
0·1	0·660	0·663	0·665	0·667	0·669	0·671	0·672	0·674	0·676	0·677	0·679	0·680	0·681	0·682	0·683
	113·8	118·8	123·8	128·9	134·0	139·1	144·1	149·1	154·2	159·3	164·4	169·4	174·5	179·6	184·7
0·2	0·903	0·906	0·909	0·912	0·915	0·918	0·920	0·923	0·925	0·927	0·929	0·931	0·932	0·933	0·934
	155·6	162·6	169·6	176·6	183·5	190·4	197·4	204·4	211·3	218·2	225·1	232·0	238·9	245·7	252·5
0·3	1·094	1·098	1·101	1·104	1·107	1·110	1·113	1·116	1·118	1·120	1·122	1·124	1·126	1·128	1·130
	188·6	196·9	205·2	213·5	221·8	230·2	238·5	246·8	255·1	263·5	271·9	280·3	288·7	297·1	305·5
0·4	1·255	1·259	1·263	1·266	1·270	1·273	1·276	1·279	1·282	1·284	1·286	1·288	1·290	1·292	1·294
	216·3	225·8	235·3	244·8	254·4	264·0	273·5	283·0	292·5	302·1	311·7	321·3	330·8	340·3	349·8
0·5	1·396	1·400	1·404	1·408	1·412	1·415	1·418	1·421	1·424	1·427	1·430	1·432	1·434	1·436	1·438
	240·6	251·1	261·7	272·3	282·9	293·5	304·1	314·7	325·3	335·9	346·5	357·1	367·7	378·3	388·8
0·6	1·524	1·529	1·534	1·538	1·542	1·546	1·549	1·553	1·556	1·559	1·562	1·565	1·567	1·569	1·571
	262·7	274·2	285·8	297·4	309·0	320·6	332·2	343·8	355·4	367·0	378·6	390·2	401·7	413·2	424·7
0·7	1·642	1·647	1·652	1·657	1·661	1·665	1·669	1·673	1·676	1·679	1·682	1·685	1·688	1·691	1·694
	283·0	295·4	307·8	320·3	332·8	345·3	357·7	370·1	382·6	395·1	407·6	420·2	432·8	445·4	458·0
0·8	1·751	1·756	1·761	1·766	1·771	1·776	1·780	1·784	1·787	1·790	1·794	1·797	1·800	1·803	1·806
	301·8	315·1	328·4	341·7	355·0	368·3	381·6	394·9	408·2	421·5	434·8	448·1	461·5	474·9	488·3

0·9	1·856 319·9	1·862 334·0	1·868 348·1	1·873 362·2	1·878 376·3	1·883 390·5	1·887 404·6	1·891 418·7	1·895 432·8	1·898 446·9	1·902 461·0	1·905 475·1	1·908 489·2	1·911 503·3	1·914 517·5
1·0	1·957 337·3	1·963 352·1	1·969 366·9	1·975 381·8	1·980 396·7	1·985 411·6	1·989 426·4	1·993 441·3	1·997 456·2	2·001 471·1	2·005 486·0	2·009 500·9	2·012 515·8	2·015 530·7	2·018 545·6
1·2	2·144 369·6	2·151 385·8	2·157 402·0	2·163 418·2	2·169 434·5	2·174 450·8	2·179 467·0	2·184 483·3	2·188 499·6	2·192 515·9	2·196 532·2	2·200 548·6	2·204 565·0	2·208 581·5	2·212 598·0
1·4	2·315 399·0	2·323 416·6	2·330 434·2	2·337 451·8	2·343 469·4	2·349 487·1	2·354 504·7	2·359 522·3	2·364 539·9	2·369 557·5	2·373 575·2	2·377 592·9	2·381 610·6	2·385 628·3	2·389 646·0
1·6	2·475 426·6	2·483 445·4	2·491 464·2	2·498 483·0	2·504 501·8	2·510 520·6	2·516 539·4	2·522 558·2	2·527 577·0	2·532 595·8	2·536 614·6	2·540 633·4	2·544 652·2	2·548 671·0	2·552 689·9
1·8	2·625 452·5	2·634 472·4	2·642 492·3	2·650 512·2	2·657 532·2	2·663 552·2	2·669 572·1	2·675 592·0	2·680 611·9	2·685 631·9	2·690 651·9	2·695 671·8	2·699 691·8	2·703 711·8	2·707 731·8
2·0	2·767 471·1	2·776 498·1	2·784 519·1	2·792 540·1	2·800 561·1	2·807 582·1	2·814 603·1	2·820 624·1	2·825 645·1	2·830 666·1	2·835 687·1	2·840 708·2	2·845 729·4	2·850 750·7	2·855 772·0

SUPPLEMENTARY TABLE,

GIVING PERCENTAGES OF MEAN VELOCITY AND OF DISCHARGE TO BE ADDED TO OR SUBTRACTED FROM THE QUANTITIES GIVEN IN THE PRECEDING TABLES FOR OTHER SECTIONS OF CHANNEL.

For Depths of Water of	Mean Velocities of Discharge.					Quantities Discharged per Second.				
	For Side-Slopes of					For Side-Slopes of				
	1 to 0.	1 to 0·5.	1 to 1.	1 to 2.	1 to 3.	1 to 0.	1 to 0·5.	1 to 1.	1 to 2.	1 to 3.
0·2	− 15·0	− 4·6	− 0·2	− 0·7	− 3·8	− 55·2	− 31·5	− 14·7	+ 16·3	+ 39·0
0·4	− 11·7	− 2·5	0·	− 1·0	− 3·8	− 45·0	− 27·0	− 12·3	+ 11·3	+ 32·7
0·6	− 8·6	− 1·2	+ 0·2	− 1·2	− 3·8	− 36·8	− 22·8	− 10·5	+ 9·8	+ 27·0
0·8	− 6·4	− 0·3	+ 0·3	− 1·3	− 3·8	− 30·4	− 19·3	− 9·1	+ 8·0	+ 22·2
1·0	− 4·8	+ 0·2	+ 0·4	− 1·4	− 3·8	− 25·4	− 16·2	− 8·0	+ 6·5	+ 18·3
1·2	− 3·6	+ 0·6	+ 0·5	− 1·4	− 3·8	− 21·3	− 13·4	− 6·9	+ 5·2	+ 15·1
1·4	− 2·6	+ 0·8	+ 0·7	− 1·4	− 3·8	− 18·7	− 11·2	− 6·0	+ 4·6	+ 12·7
1·6	− 1·8	+ 0·9	+ 0·8	− 1·4	− 3·8	− 16·7	− 9·7	− 5·1	+ 3·8	+ 11·2
1·8	− 1·3	+ 1·0	+ 0·9	− 1·4	− 3·8	− 15·1	− 8·7	− 4·3	+ 3·3	+ 10·0
2·0	− 0·9	+ 1·0	+ 1·0	− 1·4	− 3·8	− 13·8	− 7·8	− 3·4	+ 2·9	+ 8·8
2·2	− 0·6	+ 1·0	+ 1·1	− 1·4	− 3·7	− 12·7	− 7·2	− 2·9	+ 2·6	+ 8·0
2·4	− 0·5	+ 1·0	+ 1·2	− 1·3	− 3·6	− 11·8	− 6·8	− 2·4	+ 2·4	+ 7·4
2·6	− 0·4	+ 1·0	+ 1·3	− 1·3	− 3·4	− 11·0	− 6·3	− 2·0	+ 2·3	+ 6·9
2·8	− 0·3	+ 1·0	+ 1·4	− 1·3	− 3·3	− 10·3	− 5·9	− 1·7	+ 2·1	+ 6·5
3·0	− 0·2	+ 1·0	+ 1·4	− 1·2	− 3·2	− 9·7	− 5·4	− 1·6	+ 2·0	+ 6·0
3·5	− 0·2	+ 1·0	+ 1·5	− 1·0	− 2·9	− 8·3	− 4·7	− 1·0	+ 1·8	+ 5·0
4·0	− 0·1	+ 0·9	+ 1·5	− 0·9	− 2·6	− 7·1	− 3·8	− 0·8	+ 1·5	+ 4·2
4·5	− 0·1	+ 0·8	+ 1·4	− 0·8	− 2·3	− 6·1	− 3·2	− 0·8	+ 1·3	+ 3·7
5·0	0·	+ 0·8	+ 1·2	− 0·7	− 2·0	− 5·3	− 2·8	− 0·8	+ 1·1	+ 3·3
5·5	0·	+ 0·7	+ 0·9	− 0·6	− 1·7	− 4·7	− 2·5	− 0·9	+ 1·0	+ 3·0
6·0	0·	+ 0·6	+ 0·5	− 0·5	− 1·4	− 4·2	− 2·3	− 0·9	+ 0·9	+ 2·8

TABLE OF CONTENTS.

CHAPTER I.

FLOW IN OPEN CHANNELS GENERALLY.

CHAPTER II.

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